PB-227 039

MANPOWER REQUIREMENTS FOR WASTE WATER COLLECTION SYSTEMS IN CITIES AND TOWNS UP TO 150,000 IN POPULATION

North Carolina Agricultural and Technical
State University

Prepared for:

Environmental Protection Agency

June 1973

DISTRIBUTED BY:

NTIS
National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

PB 227 039

MANPOWER REQUIREMENTS FOR WASTE WATER COLLECTION SYSTEMS IN CITIES AND TOWNS UP TO 150,000 IN POPULATION

Manpower Development Staff
Office of Water Program Operations
U.S. Environmental Protection Agency
Washington, D.C. 20460

Center for Manpower
Research and Training
North Carolina A&T State University
Greensboro, North Carolina 27411

Grant Award No. T-900211

June 1973

124

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U S Department of Commerce
Springfield VA 22151

TABLE OF CONTENTS

PAGE

Acknowledgment ii
Preface iii
Chapter 1: Introduction 1
Chapter 2: Wastewater Collection System 5
Chapter 3: Determination of Quantitative Manpower Requirements 16
Chapter 4: Occupational Descriptions 28
Chapter 5: Description of Tasks 83
Appendix 1: Definitions of Worker Traits 103
Appendix 2: Glossary 112
Appendix 3: Bibliography 119

ALPHABETICAL INDEX OF OCCUPATIONAL TITLES

Occupational Title Page

Assistant Superintendent 33
Automotive Equipment Operator 58
Clerk Typist 81
Construction Equipment Operator 56
Construction Inspector 74
Construction Inspector Supervisor 71
Dispatcher 77
Foreman 39
Laborer 63
Maintenance Equipment Operator 53
Maintenance Man II 42
Maintenance Man I 45
Maintenance Mechanic II 65
Maintenance Mechanic I 67
Maintenance Mechanic Helper 69
Maintenance Supervisor 36
Mason II 48
Mason I 51
Photo-Inspection Technician 60
Stock Clerk 79
Superintendent 30

ACKNOWLEDGMENT

Special appreciation is expressed to Robert C. Rose, Project Director, and Roger K. Brittingham, Manpower Development Specialist, both from the U.S. Environmental Protection Agency, Office of Water Program Operations, Washington, D.C.; to Arthur Gurley, Jr., Manpower Development Specialist, E.P.A. Region IV, Atlanta, Ga.; and to James R. Gardner, Stan M. Rose, and Michael Swaim, Occupational Analysts, North Carolina Occupational Analysis Field Center, for their sustaining cooperation and assistance.

Grateful acknowledgment is extended to the municipal employees of the following cities in North Carolina for their invaluable contribution in providing information for this manual: Greensboro, High Point, Burlington, Asheboro, and Siler City.

Appreciation is also extended to wastewater control officials of Abermarle, N.C., Anderson, S.C., Athens, Tenn., Berkeley, Calif., Bloomington, Minn., Bristol, Tenn., Campbell, Calif., Chapel Hill, N.C., Chattanooga, Tenn., Chula Vista, Calif., Colorado Springs, Col., Clovis, Calif., Concord, N.C., Denver, Col., Downey, Calif., Durham, N.C., East St. Louis, Ill., Encinitas, Calif., Falmouth, Me., Fayetteville, N.C., Gaffney, S.C., Gainsville, Ga., Golden Valley, Minn., Granite City, Ill., Greenville,S.C., Greer, S.C., Johnson City, Tenn., Kernerville, N.C., Leucadia, Calif., Lexington, N.C., Lynchburg, Va., Lynn, Mass., Madison, Ill., Martinsville, Va., Massachusetts Metropolitan District Commission, Boston, Mass., Metropolitan St. Louis Sewer District, Mo., Oxford, N.C., Peabody, Me., Raleigh, N.C., Reidsville, N.C., Roanoke, Va., Rome, Ga., Roxboro, N.C., St. Clara County, Calif., St. Louis Park, Minn., Salem, Va., Salisbury, N.C., San Diego County, Calif., Sanford, N.C., South Portland, Me., South Boston, Va., Spartanburg, S.C., Statesville, N.C., Sweetwater, Tenn., Tempe, Ariz., Thomasville, N.C., Winston-Salem, N.C.

PREFACE

Our consciousness of pollution has deepened in recent years. With increasing population, urbanization, and industrialization, we are becoming alarmed that water pollution will worsen unless adequate measures are taken to alleviate the problem. The recent 1972 amendments to the Water Pollution Control Act are only the latest and most visible example of increased interest in this area. Upgrading the collection and treatment of waste water is crucial in the water pollution abatement and control area.

The water pollution control field is growing considerably due to higher standards and facilities construction, thereby increasing the demand for skilled personnel. Developing adequately trained manpower will be our biggest challenge. This Manual is written to provide occupational information on job duties and worker traits with important implications to system staffing and training. It identifies specific manpower requirements, in terms of type and number, which are needed to operate and maintain waste water collection systems in cities and towns up to 150,000 in population. Occupational Descriptions and Staffing Guides have been developed to assist officials in charge of manpower staffing and training. Users should bear in mind that information contained in this manual is of a composite nature and does not necessarily apply to specific systems. To be of maximum utility, manpower and training estimates based on such data should be supplemented by information on local conditions.

This study was directed by Mr. Elie Namour of the Center for Manpower Research and Training at North Carolina A & T State University. The Center for Manpower Research and Training is supported by the U.S. Department of Labor to educate students and conduct research in the field of human resource development. Project staff consisted of two research assistants, Mr. Charles Galbreath and Mrs. Dorothy Warren, and five students who assisted in data collection during the summer of 1972. Acting as consultants were Mr. Arthur L. White, Engineering Technician, City of Greensboro, N.C. and Dr. John Boulger, Industrial Psychologist, Director of Psychological Services, Farr Associates, Greensboro, N.C. Chapter 2 "Waste Water Collection System" was prepared with the assistance of Dr. Charles Smallwood Jr., Professor of Civil Engineering at North Carolina State University, Raleigh, N.C. and Sanitary Engineer Donald E. Knibb, Chief Engineer, Water and Sewer Division, City of Greensboro, N.C. The Department of Labor's Occupational Analysis Field Center in Raleigh, N.C. provided advisory assistance and training for research personnel of the project. The Center also reviewed the Occupational Descriptions presented in this Manual.

1. INTRODUCTION

The Federal Water Pollution Control Act Amendments of 1972 designed to "eliminate the discharge of pollutants" gave impetus to the construction of wastewater collection systems and the development of waste management methods. It also imposed stringent requirements for reliable wastewater collection operation and maintenance. The Environmental Protection Agency (EPA), created by executive order in December, 1970, leads and coordinates pollution control activities set forth in the Water Pollution Control Act and its 1972 Amendments. Among its many water responsibilities are the establishment and enforcement of water quality standards, issuance of grants for the construction of public wastewater treatment plants and collection systems, and funding of research and demonstration projects pertaining to proper operation and maintenance methods and procedures, design criteria, and new systems development. It also provides technical and financial support for the assessment of manpower requirements and the training of needed personnel in water pollution control. The EPA, through its Manpower Development Staff of the Office of Water Program Operations, has undertaken the development, maintenance, and dissemination of manpower planning methods, tools, and techniques to provide a sufficient number of properly trained personnel in the water pollution control field.

Since adequate manpower is a key element in the success of antipollution activities, the unemployed and the disadvantaged provide an untapped resource. Utilization of minority group personnel would not only draw from a largely unrecognized source of manpower but also provide an avenue of employment and self-betterment for members of these groups. As a result, plans are needed to recruit, train, and provide avenues of promotion for disadvantaged personnel within wastewater collection systems.

PURPOSE:

This Manpower Manual was prepared to meet the growing need for manpower information in the water pollution control field. It develops manpower requirements for the effective operation and maintenance of wastewater collection systems in cities and towns less than 150,000 in population. It is designed to identify specific occupations in the form of Occupational Descriptions that include the main duties, working conditions and physical demands of the jobs required as well as the behavioral and psychological traits the workers must possess to perform the required tasks satisfactorily. It develops Staffing Guides that quantify manpower requirements by occupation to assist manpower planners, trainers, wastewater collection administrators in making a better selection of workers and more efficient use of resources. Task Descriptions are also included to provide the basis for developing curriculums and training programs.

SCOPE:

Manpower is an important element in the water pollution control field which is expected to continue to grow at an accelerated rate, creating more and perhaps different jobs that need to be filled. Identifying the jobs required to maintain an efficient wastewater collection system and preparing Staffing Guides are the basic objectives of this research. This Manual provides a practical, general framework for manpower planning. It covers field occupations that are entirely or primarily involved with the REPAIR, CLEANING, INSPECTION, and PREVENTIVE MAINTENANCE of storm sewers, sanitary sewers, and waste water pumping stations (lift stations). The following twenty-one occupations were identified:

- Superintendent
- Assistant Superintendent
- Maintenance Supervisor
- Foreman
- Maintenance Man II
- Maintenance Man I
- Mason II
- Mason I
- Maintenance Equipment Operator
- Construction Equipment Operator
- Automotive Equipment Operator
- Photo-Inspection Technician
- Laborer
- Maintenance Mechanic II
- Maintenance Mechanic I
- Maintenance Mechanic Helper
- Construction Inspector Supervisor
- Construction Inspector
- Dispatcher
- Stock Clerk
- Clerk Typist

It was observed that most cities contract out the construction of new sanitary and storm sewers. As a result, construction related jobs were not analyzed in this Manual and were considered to be beyond the scope of the study. It should be pointed out, however, that typical sewer construction occupations are identified in the Dictionary of Occupational Titles. In addition, this study does not cover plumbing inspection, billing operations, and engineering activities. The occupations in such fields are also described in the Dictionary of Occupational Titles.

This Manual consists of five chapters. Chapter 1 briefly describes the interests and responsibilities of the Environmental Protection Agency and discusses the purpose, scope, and methodology of the study. Chapter 2 identifies the different components of the wastewater collection system and describes equipment and manpower requirements needed to maintain an efficient system. Chapter 3 develops Staffing Guides for cities and towns of different sizes. Such estimates are based on field observations, numerous interviews with technical and supervisory personnel, and the judgment of the researcher. Chapter 4 presents Occupational Descriptions for the twenty-one jobs identified in the study. These descriptions consist of Occupational Definitions and the Qualification Profiles which include Formal Education, General Requirements, General Educational Development, Specific Vocational Preparation, Aptitudes, Interests, Temperament, Physical Demands, and Working Conditions. The Occupational Descriptions will be submitted to the U.S. Department of Labor for incorporation in the Dictionary of Occupational Titles. Chapter 5 presents Task Descriptions for the operation of sewer cleaning equipment and the repair and maintenance of sewers and lift stations.

METHODOLOGY:

The following summary shows the overall pattern of procedural organization in the design of the study. The research was based on field observations and interviews conducted with supervisory and technical staff. The cities studied were divided into five categories depending on the size of population. A sample of five cities in North Carolina was selected for intensive observation of all crews involved in the repair, cleaning, and maintenance of storm sewers, sanitary sewers, and waste water pumping stations (lift stations). Task Descriptions were written by trained interviewers using a prepared questionnaire.* Each work crew was observed at least twice by two different teams of interviewers. During this phase most of the tasks described were observed under a variety of environmental and operational conditions. The Task Descriptions were then properly evaluated with extensive interviews with workers, lead men, foremen, maintenance supervisors, and technical consultants.

The next phase was the acquisition of sufficient and meaningful facts on which to structure the development of Occupational Definitions and Staffing Guides free from distortion due to local or regional conditions. Fifty-four (54) cities in twelve states were visited to interview waste water control administrative personnel. Data were recorded on prepared questionnaires and available Job Specifications were studied. The following twelve (12) states were included in the sample:

State	Number of Cities
Arizona	1
California	8
Colorado	1
Georgia	2
Illinois	3
Maine	3

---

* Readers interested in becoming acquainted with data collection instruments used in the study are referred to Elie Namour, "Research Report: Manpower Requirements for Waste Water Collection Systems in Cities and Towns up to 150,000 in Population" (Washington, D.C.: U.S. Environmental Protection Agency, 1973). Included in the Research Report are statistical data, findings conclusions, and recommendations relating to staffing waste water collection systems.

State	Number of Cities
Massachusetts	2
Minnesota	3
North Carolina	16
South Carolina	5
Tennessee	5
Virginia	5
	54

2. WASTE WATER COLLECTION SYSTEM

The purpose of a waste water collection system is to accept, at the point of origin, liquid waste and to convey it in essentially unaltered condition to treatment points and then to carry treated waste water to a receiving body of water.

There are three types of sewerage systems. The storm sewer is the oldest type and has been uncovered in the most ancient cities. It has the function of carrying runoff from rainfall quickly away from streets and parking lots so that transport is not impeded.

The combined sewer is the second type in a historical view. Sanitary waste water was first introduced into storm sewers in the mid-nineteenth century and the sewers were then called Combined Sewers. During dry weather there is always a small flow of sanitary waste water and during storms it is mixed with the very large volume of storm runoff.

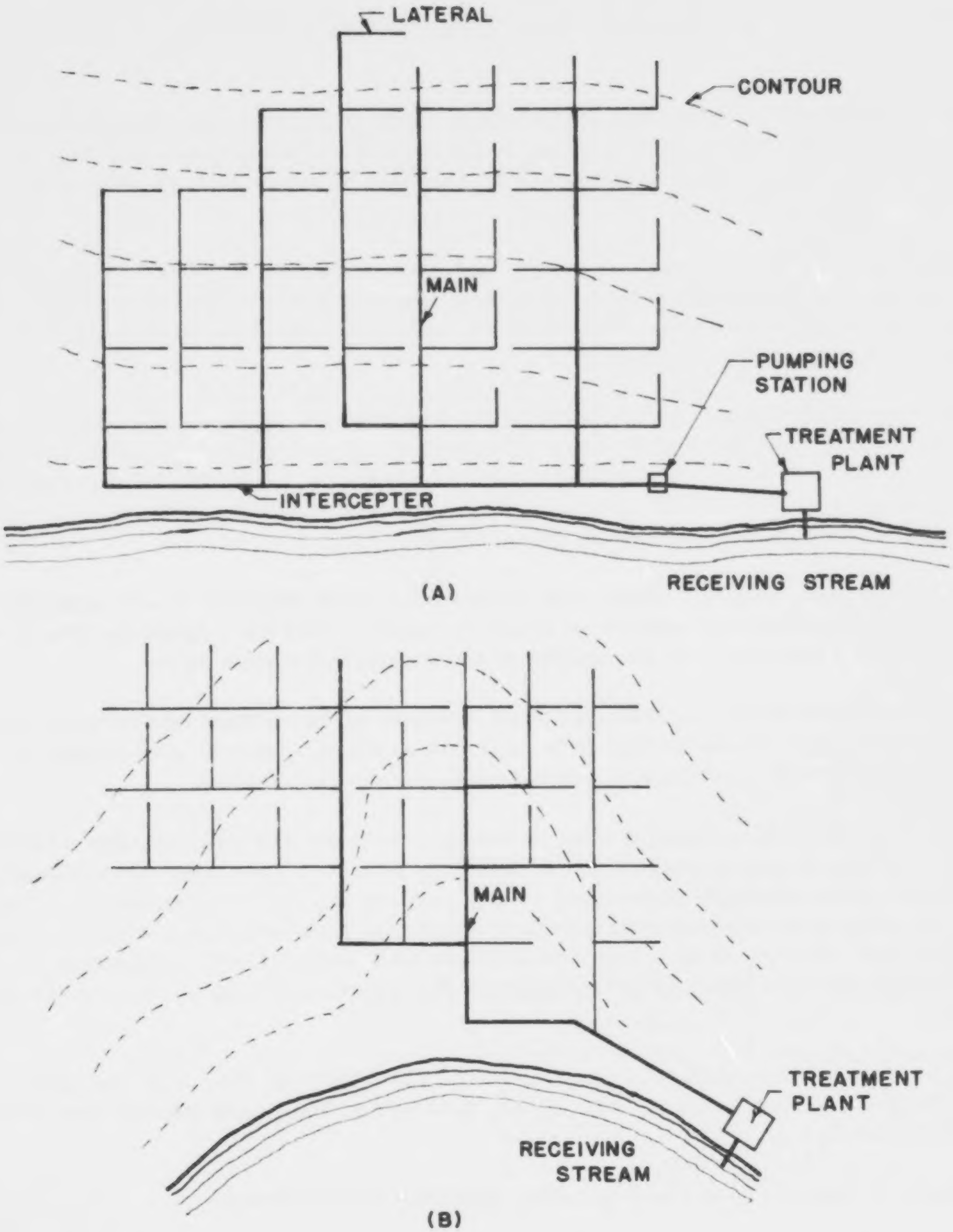
The separate sanitary sewer was introduced about the turn of the century so that the objectional small volume of sanitary waste could be treated before it was discharged into harbors alongside of the untreated storm water.

The combined sewer system is found in many of our oldest and largest cities where the cost of converting to a separate system of storm and sanitary sewerage is now prohibitive. Most systems are separated.

It is important to recognize that sewerage systems are gravity flow systems and include as few pumps or other working parts as possible. Accordingly the design is strongly influenced by the topography of the community. The steep slopes of mountainous terrain introduces pipe erosion problems resulting from high velocity flow. Flat coastal systems suffer from infiltration of groundwater and from sedimentation in the pipes resulting from low velocity flow.

The common materials of sewer systems are vitrified clay and concrete although asbestos cement, cast-iron, galvanized steel and plastic are also widely used.

Figure 1 shows the variety of plans that may be employed.


LATERAL
CONTOUR
MAIN
PUMPING STATION
TREATMENT PLANT
INTERCEPTER
RECEIVING STREAM
MAIN
TREATMENT PLANT
RECEIVING STREAM

(A)

(B)

FIGURE I

STORM SEWER SYSTEMS

Storm sewer lines (Figure 1) are designed to carry surface runoff as quickly as possible to natural water course.

a. CURB AND GUTTER: In most cases the curb and gutter of the street system carry the water to a street inlet which in turn conveys the water to the storm drain. Thus the street curb and gutter are essential parts of an urban storm drain system.

b. STREET INLET: The street inlet is usually located near intersections where it accepts water from the street either through a grated street opening or through an opening in the curb. A pipe from the inlet discharges directly to the storm drain (Figure 2).

c. CATCH BASIN: The catch basin is simply a street inlet that has a deep trap that retains leaves, grit and heavy debris which otherwise would be carried into the sewer. They are utilized wherever a large amount of surface dirt is to be expected. Since they must be cleaned periodically many cities do not use them. Figure 2 illustrates the difference between the inlet and the catch basin.

d. LATERAL LINES: Lateral lines serve short residential streets and are commonly about 18 inches in diameter.

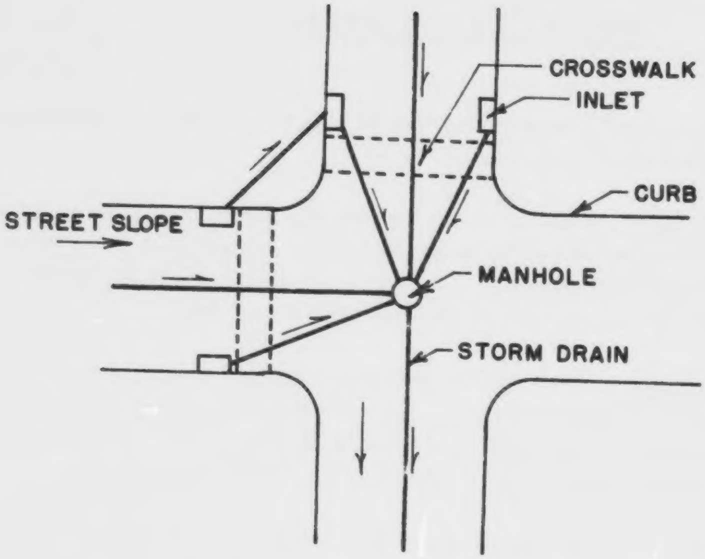
e. MAIN LINES: The main lines collect the drainage from the laterals. The size is a function of the frequency of the design storms. Downtown Business Districts may be protected against a 5 or 10 year storm. Residential neighborhoods may only be protected against a 2 or 5 year storm. Sizes thus may go to 72 inches in diameter.

f. INTERCEPTORS: These lines intercept flow from the mains before it is discharged to a stream. They then guide the flow parallel to a stream to a point where the flow may be released without danger of eroding stream banks or to a point of treatment.

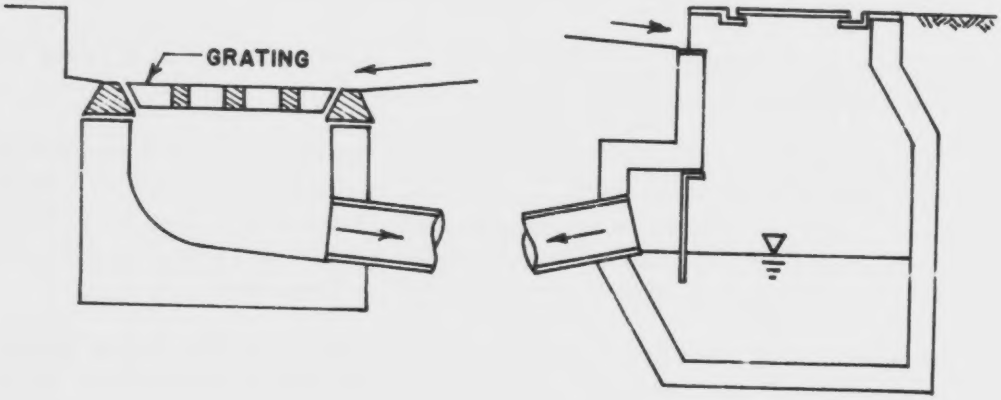
g. OUTFALLS: Outfalls carry flow into a receiving body of water. An interceptor may become the outfall if there is no treatment plant as in most storm systems.

COMBINED SEWER SYSTEM

The extremely wide variation of flow in a combined sewer ranging from very small nightime sanitary waste flows to very large storm flows require the


CROSSWALK
INLET
CURB
STREET SLOPE
MANHOLE
STORM DRAIN

INTERSECTION
PLAN



INLET

CATCH BASIN

FIGURE 2

introduction of special bypass devices so that large excess flows go directly to a receiving body of water. The normal sanitary or "dry weather" flow is diverted to the treatment plant.

a. LEAPING WEIRS: Normal sanitary waste water drops through a vertical pipe (see Figure 3). Large flows "leap" over the opening of the vertical pipe and go to the point of discharge.

b. DIVERTING WEIRS: Normal sanitary waste water flow is turned from its normal direction of flow and is "diverted" to the treatment plant. Storm flows are very large and pass over the weir to the discharge point.

c. SIPHON SPILLWAY: The siphon is only activated by very large storm water flows and then diverts flow directly to stream. Low sanitary or "dry-weather" flow goes to a treatment point.

SANITARY SEWER SYSTEMS

Sanitary sewer systems include laterals, the mains, the interceptors, and the outfalls similar to the storm sewer system (see Figure 1). They differ from storm drainage systems in that they are normally smaller (laterals are 8 inches in sanitary and perhaps 18 inches in storm systems). They are also commonly much deeper in the ground than a storm drain. They must be sufficiently deep to catch waste from household basements.

The "house connection" is either a 4 inch cast-iron pipe or a 6 inch vitrified clay pipe that connects the house drains to the lateral or main.

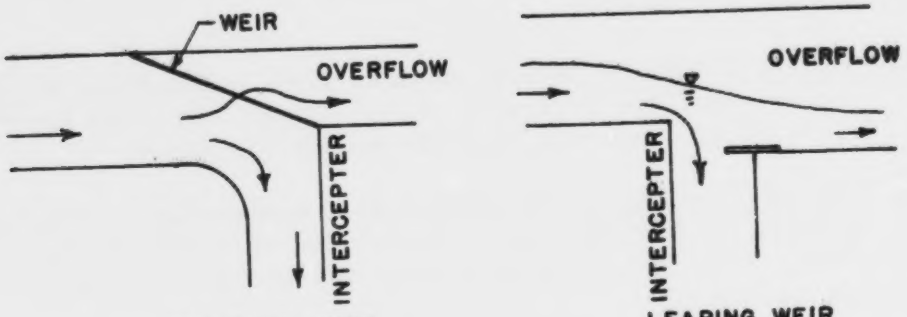
Infiltration is an undesirable result of placing sanitary sewers so deep. Additional maintenance to minimize infiltration and avoid expensive waste treatment is usually required to keep lines and manholes tight against external water.

It is also necessary to inspect and insure that illegal connections are not made. Such illegal connections would include:

a. Connections to roof leaders.

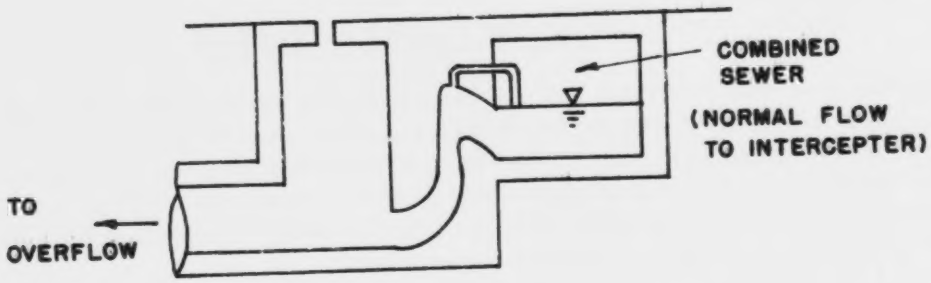
b. Discharges of acid or alkali from chemical processing.

c. Drainage from gas service stations that might have oil or gasoline in it.

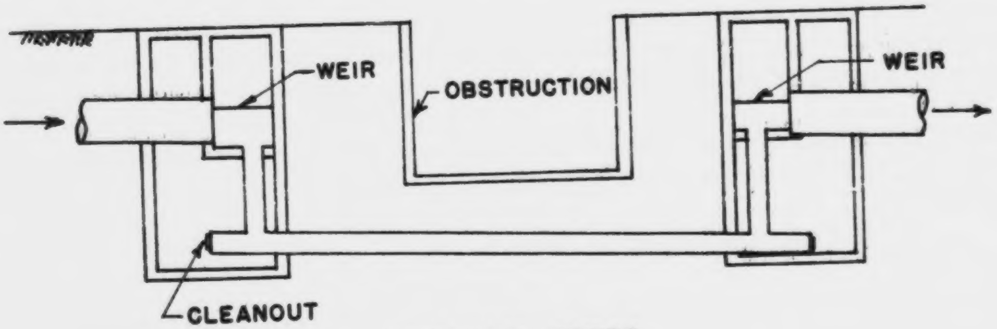

WEIR
OVERFLOW
INTERCEPTER
OVERFLOW
INTERCEPTER

DIVERTING WEIR
PLAN

LEAPING WEIR
VERTICAL SECTION


COMBINED
SEWER
(NORMAL FLOW
TO INTERCEPTER)
TO
OVERFLOW

SIPHON SPILLWAY – VERTICAL SECTION


WEIR
OBSTRUCTION
WEIR
CLEANOUT

DEPRESSED SEWER

FIGURE 3

APPURTENANCES

MANHOLES:

Manholes (Figure 4) are ground surface openings in a sewer and serve many purposes among which are the following:

a. Access to sewers for men and equipment. Equipment usually dictates a bottom diameter of at least 4 feet.

b. Vents to prevent accumulation of explosive or toxic gases.

c. Vents to prevent corrosion by hydrogen sulfide.

d. Provide locations for gauging flow.

e. Allow for changes in direction of flow.

f. Allow for connections at different elevations.

g. Allow for reductions in velocity.

h. Relief valve for excessive flows especially in storm drainage systems.

i. Allow for changes in pipe sizes.

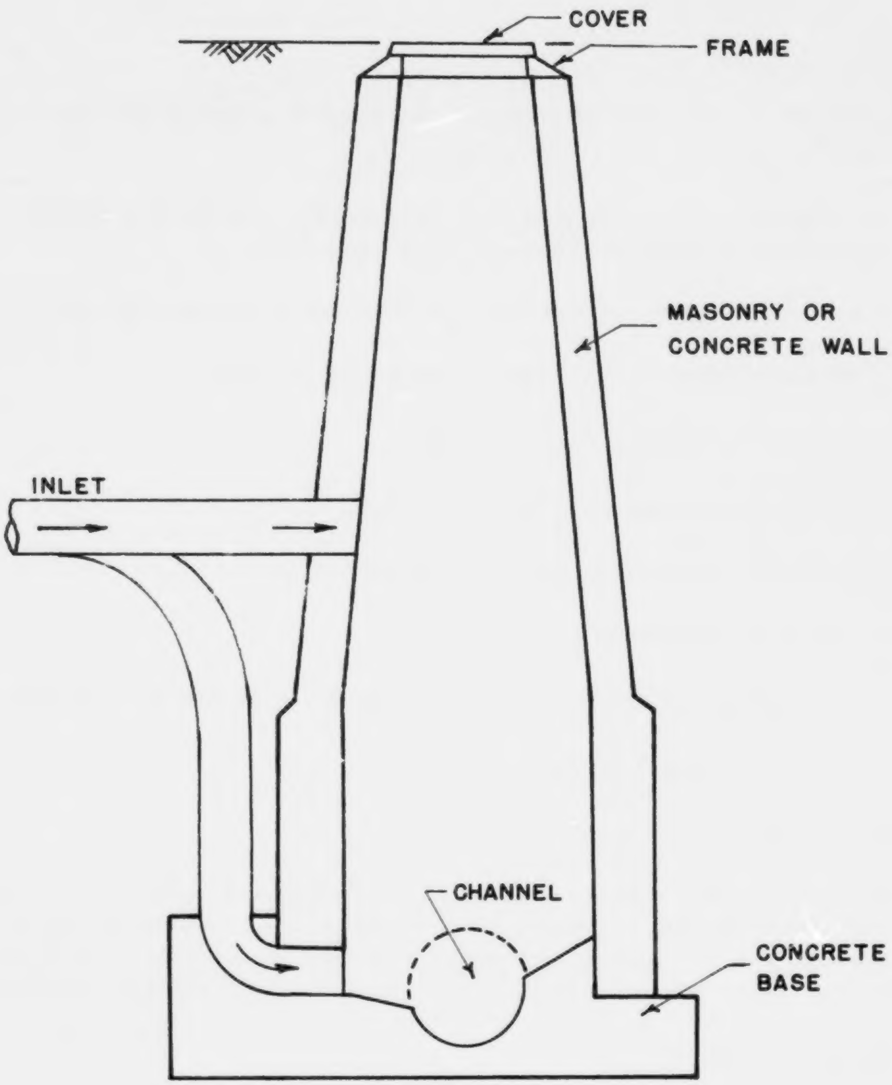
INVERTED SIPHON:

A sewer line requiring a sudden change in grade to pass under an obstruction and then a grade reversal to regain its original slope. Waste water in the depressed section of the pipe is not always flowing and solids tend to drop out and collect in the low points, resulting in a continuous maintenance problem.

PUMP AND LIFT STATIONS:

When waste water connot be carried by gravity over a ridge or past an obstacle it may be necessary to "pump" the sewage into a "pressure main" that carries it to a treatment plant. In other cases it may be sufficient to "lift" the waste water from a low lying gravity sewer to another gravity sewer at a higher elevation.

Lift stations frequently use compressed air in alternating chambers to "push" the water higher and to avoid moving parts in contact with the flow. Pumps must have non-clog impellers so that solids in the waste water do not damage the pump.


COVER
FRAME
MASONRY OR
CONCRETE WALL
INLET
CHANNEL
CONCRETE
BASE

DROP MANHOLE
SECTION

FIGURE 4

MAINTENANCE PROGRAM

What should be done to ensure that the system will continue to operate smoothly without blockages and without disrupting service? The following methods of operation would enhance the collection system maintenance:

a. The location of all lines must be clearly shown on readily available maps.

b. All lines should be accessible and rights-of-way cleared.

c. Construction should be of good undamaged materials placed under careful inspection.

d. Spacing of manholes should dictate the length of cables in any cleaning device.

e. Establishment of proper preventive maintenance procedures that include scheduled routine inspection and cleaning of the different elements of the waste water collection system.

f. Perhaps one-tenth of the total mileage of line will require half of the maintenance effort. Sufficient equipment and personnel should be available so that these troublesome areas are cleaned as often as the situation dictates.

g. Continuous inspection for illegal connections and illegal discharges is desirable.

h. The origin of all inspections and all maintenance operations should be the point of discharge so that serious blocks downstream can be avoided.

i. Known breaks should be repaired prior to any routine cleaning to avoid additional damage.

j. Mechanical units such as pumps will require continuous maintenance.

MAJOR EQUIPMENT

POWER RODDER:

Used to control root intrusion. The power rodder can either be truck mounted or trailer mounted. For best mobility on typical urban streets, the truck mounted power rodder is preferred. This rodder has the equipment to unstop mains from 8 inches in diameter to about 36 inches in diameter. The crew should be equipped with three men to provide safe operation and safe handling of traffic problems created by working at manholes at street intersections. The truck should be equipped with at least 500 feet of rods and a complete set of tools involving all sizes of cutters.

HIGH VELOCITY WATER JET:

The Water Jet should be truck mounted. The truck should be equipped with a minimum of 500 feet of hose and a variety of nozzles for various size lines and types of problems. Basically, the machine works with pressures of approximately 1,000 PSI with a majority of holes in the nozzles jetting to the rear, so that the hydraulic power pulls the nozzle through the line and flushes the solids in the line downstream. This machine is most effective in pipe sizes of 8 inches through 15 inches in diameter.

BUCKET MACHINE:

This sewer cleaning equipment is primarily used for removal of large quantities of silt and grit from outfall lines. The bucket is pulled through the line between two manholes by means of a winch with the bucket's jaws open to scoop up debris. When full, the bucket travel is reversed with its jaws closed and is returned to ground level at first manhole where it is emptied.

WAYNE BALL MACHINE:

It uses a spirally grooved ball which is inserted into the sewer line and water is pumped into the manhole. This water passes around the ball through the spiral grooves that loosens dirt from the walls of the line and drives the ball forward forcing the accumulated debris ahead to the next manhole for removal.

VAC-ALL:

This cleaning equipment removes solids from a manhole as they are deposited by a high velocity cleaner and returns the water to the sewer in a sanitary method.

PHOTO-INSPECTION SYSTEM:

A camera is inserted and pulled through the sewer line to take pictures manually or automatically at specified intervals to determine the condition of the pipe and the need for repairs.

TELEVISION INSPECTION SYSTEM:

A closed circuit television system is utilized for remote visual inspection of sewer lines. A TV camera is drawn through the line and a TV monitor shows the condition of the sewer.

TELEGROUT SYSTEM:

A sewer sealing equipment is used in conjunction with a television camera for remote internal repair of leaking sewer lines. The equipment is pulled through the pipe, its packer is inflated and a chemical grout compound is pumped over the suspected leak to seal the line.

SEWER RELINING SYSTEM:

A Polyethelene pipe that has been joined by a heat fusion process is inserted through the old sewer line.

THE FUTURE

Advancement will continue in three areas: equipment, materials, and manpower utilization. In the area of equipment, we will see improvement in the technique of internal pipe inspection. The TV camera will be coupled with cleaning tools so that the equipment operator can actually see what needs to be done and to assist him in doing it. This will lead to development of better tools such as high pressure cleaners (3,000 psi), remote control clam buckets, vacuum excavators, and pavement and rock saws (in lieu of jack hammers).

A major breakthrough is coming in materials. The jointless or seamless pipe that can be laid without manholes at every grade or alignment change will allow the lines to follow curved sub-division streets more economically. The primary reason for the old straight lines and grades was to facilitate manual visual inspection from manhole to manhole and to allow cleaning with tools with limited capabilities.

The greatest breakthrough will be in manpower utilization. We now stumble along with efficiencies similar to the internal combustion engine. Motivation, training, supervision, and maintenance management will all be developed.

3. DETERMINATION OF QUANTITATIVE MANPOWER REQUIREMENTS

MANPOWER DETERMINANTS:

The determination of manpower needs for wastewater collection systems is a complex problem requiring the consideration of many variables. Among the more important ones are:

1. The size of the system in miles of sewer lines.
2. The age of the system.
3. The standard of sewer construction.
4. Funds available in the budget.
5. The scope of the municipality's responsibility such as the maintenance of lateral lines.
6. The extent of contractors' use.
7. The establishment of minimum maintenance capabilities.
8. The type of equipment used.
9. The accessibility of work sites to equipment.
10. Distances work crews have to travel.
11. The topography of the area.

The translation of these multiple factors into working figures is a difficult undertaking. Factorial characteristics are different for each system and there is no single predominating parameter which can be utilized as a reliable determinant of staffing needs.

CREW FUNCTIONS:

Manpower requirements are more logically evaluated in terms of crew functions. To maintain an efficient wastewater collection system, certain tasks must be performed. Sewer lines must be inspected, cleaned, opened, and repaired. Appurtenances such as manholes must be checked, patched, cleaned, their walls raised, and their covers repaired. Pumping stations must be inspected, and their mechanical and electrical equipment adjusted and repaired. A recommended approach is one where scheduled routine preventive maintenance dominates work activities rather than the mad rush to emergencies. The next step is to determine the types and sizes of crews needed to perform the above mentioned duties. Figures 5 through 10 show typically acceptable organization charts for the maintenance of wastewater collection systems in cities with the following population sizes: 5,000, 10,000, 25,000, 50,000, 100,000 and 150,000. The preparation of these charts was based on extensive field observations, numerous interviews with supervisory personnel in different localities, and the judgment of the researcher. The charts include functions of crews, titles of workers, number of personnel required, and total man hours per week. The description of each worker's duties can be found in Chapter 4. It should be pointed out that judgment must be exercised by the user since the factors which control and modify manpower requirements are numerous and should be supplemented by local consideration. With the exercise of due caution, the charts provided in this chapter should be useful in providing preliminary approximation of requisite staffing needs. In short, weight should be given to local conditions that may modify the estimated values.

CONSTRUCTION INSPECTION AND LIFT STATION MAINTENANCE:

Manpower requirements for the inspection of new sewer construction and the maintenance of lift stations are not related to size of city population which has been selected as the predominate staffing determinate. Construction inspection is predominately determined by the time length of construction projects. On the average, a construction inspector spends two hours a day in the office studying blueprints and specifications in preparation for project inspections, preparing reports, and conferring with city engineers. He also spends two hours a day per site conducting field inspection of work in progress. An average day schedule consists of office work and three construction site visits. Therefore, manpower requirement in man hours per week is computed by multiplying the estimated number of daily construction site visits by 8/3. For example, 15 work site visits per week (3 per day) require 40 man hours a week (15 x 8/3 = 40). When four or more Construction Inspectors are employed, a Construction Inspector Supervisor would be needed to supervise, coordinate and schedule inspection activities on a full time basis. Upon determination of the approximate number of Construction Inspectors, the suggested man hours required for a Construction Inspector Supervisor is developed on a judgmental basis.

The maintenance of a wastewater lift station of less than 6,000 gallons per minute requires a Maintenance Mechanic I and his Helper approximately 30 minutes for each routine preventive maintenance check up, excluding travel time. A crew consisting of one Maintenance Mechanic I and one Maintenance Mechanic Helper can perfom routine preventive maintenance and minor repairs to approximately 8 lift stations a day counting travel and stand by time. Hence, the manpower requirement for each occupation is computed, in man hours per week, by multiplying the number of lift station visits per week by 1. For example, 8 lift stations visited five times per week (total of 40 visits) require 40 hours a week for Maintenance Mechanic I and 40 hours a week for Maintenance Mechanic Helper. It was observed that the overhaul and repair of pumps and equipment of 15-20 lift stations require the services of a Maintenance Mechanic II on a full time basis. Therefore, staffing needs for this occupation in man hours per week is computed by multiplying the number of lift stations by 8/3.

Computations for manpower requirements for Construction Inspection and Lift Station Maintenance are in Table 1, page 26 .

MANPOWER REQUIREMENTS:

The following analysis assumes that the maintenance of lateral lines is the responsibility of the private property owner. Otherwise, an emergency crew consisting of one Maintenance Man II and one Maintenance Man I will be required for each 50,000 people served. It also assumes that major construction of sewer lines is handled by outside contractors.

Figure 5, on page 20, illustrates one part time crew in a city or town of 5,000. A sewer system of 30 miles of sanitary main lines is assumed. The Superintendent activities are usually performed by the Director of Public Works, the City Engineer or the Director of Public Utilities. In addition to the maintenance of sewers, the crew is responsible for such public works functions as treatment plant operation and water and street maintenance. Septic tanks are widely used in cities of this size and a large number of dwellings are not sewered. Manpower needs for Construction Inspection and Lift Station Maintenance are presented in Table 1.

Figure 6, on page 21, presents wastewater collection personnel in a city or town of 10,000 with a sewer system of 70 miles of sanitary main lines. Here also a part time crew is utilized. The explanations to Figure 5 apply to Figure 6 as well.

Figure 7, on page 22, depicts the sewerage department in a city of 25,000 with a sewer system of 150 miles of sanitary main lines. Two sewer maintenance crews are needed. One sewer Cleaning Crew which deals with routine preventive and emergency maintenance and one part time Repair Crew which is large enough to perform needed repairs and the replacement of short sections of broken sewer lines. Construction Inspection and Lift Station Maintenance personnel are computed in Table 1.

Figure 8, on page 23, shows manpower requirements for a sewer system of 250 miles of sanitary main lines in a city of 50,000 in population. In addition to a Repair Crew and two Cleaning Crews, the services of a Maintenance Supervisor, a Dispatcher, a Stock Clerk and a Clerk Typist are also needed. Table 1 shows the staffing needs for Construction Inspection and Lift Station Maintenance.

Figure 9, on page 24, illustrates the sewerage staff in a city of 100,000 in population with 500 miles of sanitary main lines. Work crews consist of one Internal Inspection Crew which operates a sewer camera, one Repair Crew, and three Cleaning Crews which permit the continuous utilization of at least two crews in preventive maintenance functions. Manpower needs for Construction Inspection and Lift Station Maintenance are presented in Table 1.

Figure 10, on page 25, presents a city of 150,000 with the largest wastewater collection staff covered in this Manual. A sewerage system of 700 miles of sanitary main lines is assumed. Two Maintenance Supervisors direct and coordinate the activities of ten crews. Included in the staff are five Cleaning Crews shich use sewer cleaning equipment such as the power rodder, high velocity water jet, bucket machine, vac-all, and wayne ball machine. The Cleaning Crews handle emergency cases and follow a scheduled preventive maintenance program. Two Repair Crews and one Masonry Crew are assigned to repair and construct small sections of sewer lines, manholes, street inlets and catch basins. One Internal Inspection Crew operates a sewer camera to photograph sewer lines. The Staffing of Construction Inspection and Lift Station Maintenance is computed in Table 1.

Table 1 presents a Staffing Guide based on the organization charts already discussed. It lists manpower requirements per occupation for six cities and towns of different sizes and provides a form for preparing a staff complement. The user should read Chapter 3 before attempting to use Table 1.

CAREER LATTICE:

Figure 11, on page 27, illustrates a Career Lattice for a wastewater collection system that includes all occupations identified in this Manual except for such office jobs as Clerk Typist and Dispatcher. A Career Lattice reflects entry, promotional and transfer opportunities that exist for each worker. It "utilizes the interrelationships among jobs to create promotional opportunities and facilitate mobility of workers among jobs. A career lattice provides for mobility in three directions: horizontal mobility to jobs at the same relative level of complexity but in a different area of work, vertical mobility to more complex jobs in the same area of work, and diagonal mobility to more complex jobs in a different but related area of work."[1]

---

[1] "A Handbook for Job Restructuring" (Washington: U.S. Department of Labor, Manpower Administration, 1969, page 2).

TYPICAL ORGANIZATION CHART FOR WASTEWATER COLLECTION SYSTEM

(in man-hours per week)

1 Superintendent 5

MAINT. CREW	
1 Foreman	15
1 Maint. Man II	15
1 Maint. Man I	15
1 Laborer	15
1 Const. Eq. Op.	15

CONST. INSPECTION
- * Const. Insp. Superv.
- * Const. Inspector

LIFT STATION MAINT.
- ** Maint. Mech. II
- ** Maint. Mech. I
- ** Maint. Mech. Help.

* Determined by time length of construction projects.
** Determined by number of lift stations.

CITY POPULATION: 5,000
(see pages 16-19 for explanations)

FIGURE 5

TYPICAL ORGANIZATION CHART FOR WASTEWATER COLLECTION SYSTEM

(in man-hours per week)

1 Superintendent 10

MAINT. CREW	
1 Foreman	20
1 Maint. Man II	20
1 Maint. Man I	20
1 Laborer	20
1 Const. Eq. Op.	20

CONST. INSPECTION
* Const. Insp. Superv.
* Const. Inspector

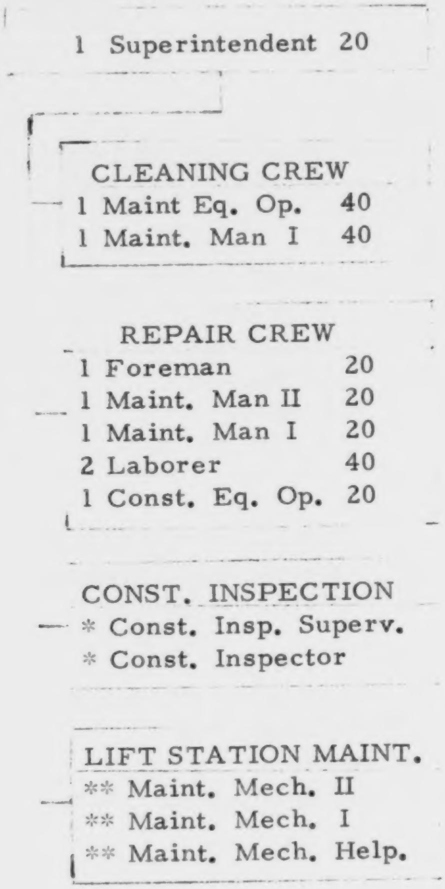
LIFT STATION MAINT.
** Maint. Mech. II
** Maint. Mech. I
** Maint. Mech. Help.

* Determined by time length of construction projects.
** Determined by number of lift stations.

CITY POPULATION: 10,000
(see pages 16-19 for explanations)

FIGURE 6

TYPICAL ORGANIZATION CHART FOR WASTEWATER COLLECTION SYSTEM
(in man-hours per week)



1 Superintendent	20

CLEANING CREW

1 Maint Eq. Op.	40
1 Maint. Man I	40

REPAIR CREW

1 Foreman	20
1 Maint. Man II	20
1 Maint. Man I	20
2 Laborer	40
1 Const. Eq. Op.	20

CONST. INSPECTION
- * Const. Insp. Superv.
- * Const. Inspector

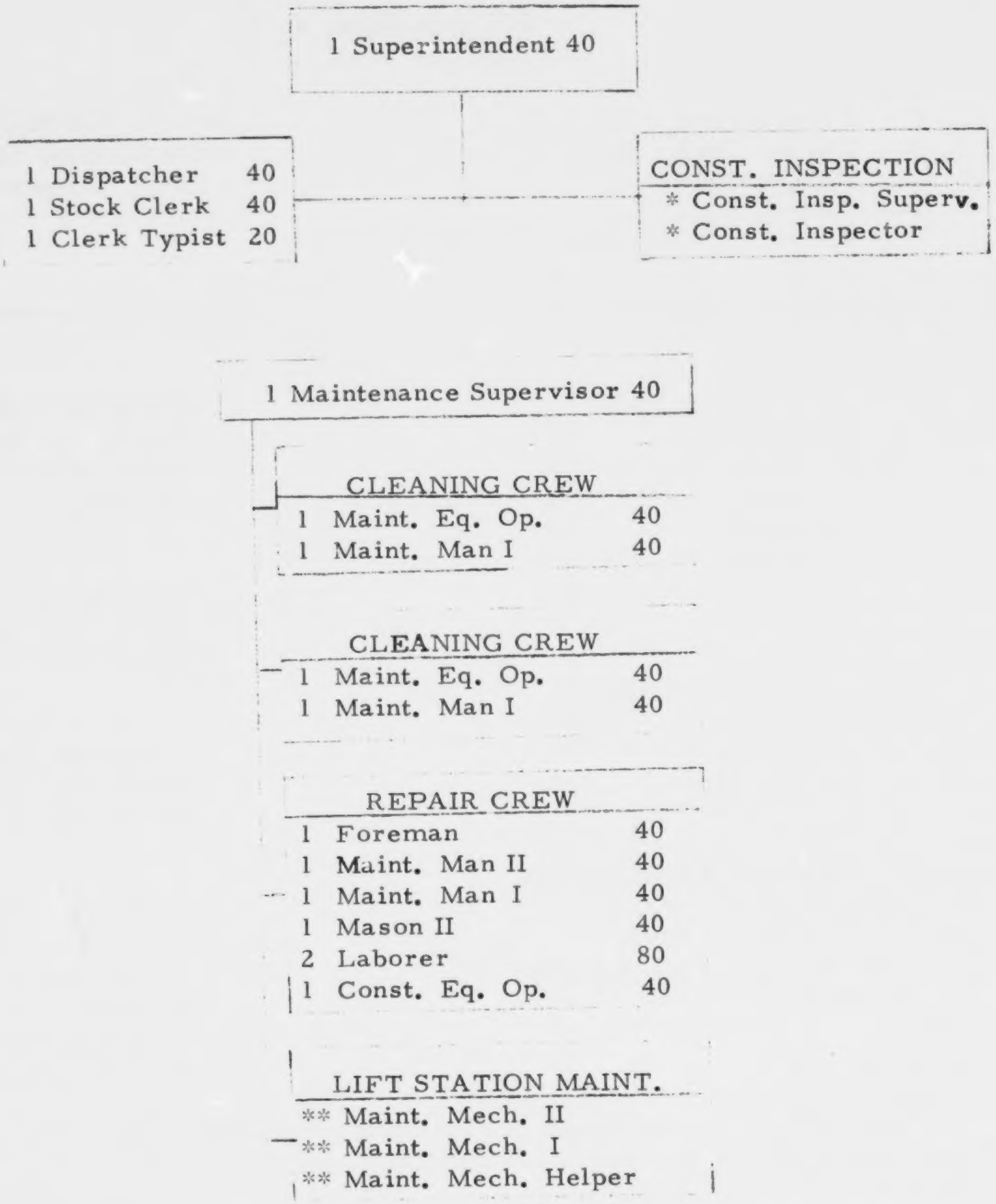
LIFT STATION MAINT.
- ** Maint. Mech. II
- ** Maint. Mech. I
- ** Maint. Mech. Help.

* Determined by time length of construction projects.
** Determined by number of lift stations.

CITY POPULATION: 25,000
(see pages 16-19 for explanations)

FIGURE 7

TYPICAL ORGANIZATION CHART FOR WASTEWATER COLLECTION SYSTEM
(in man-hours per week)

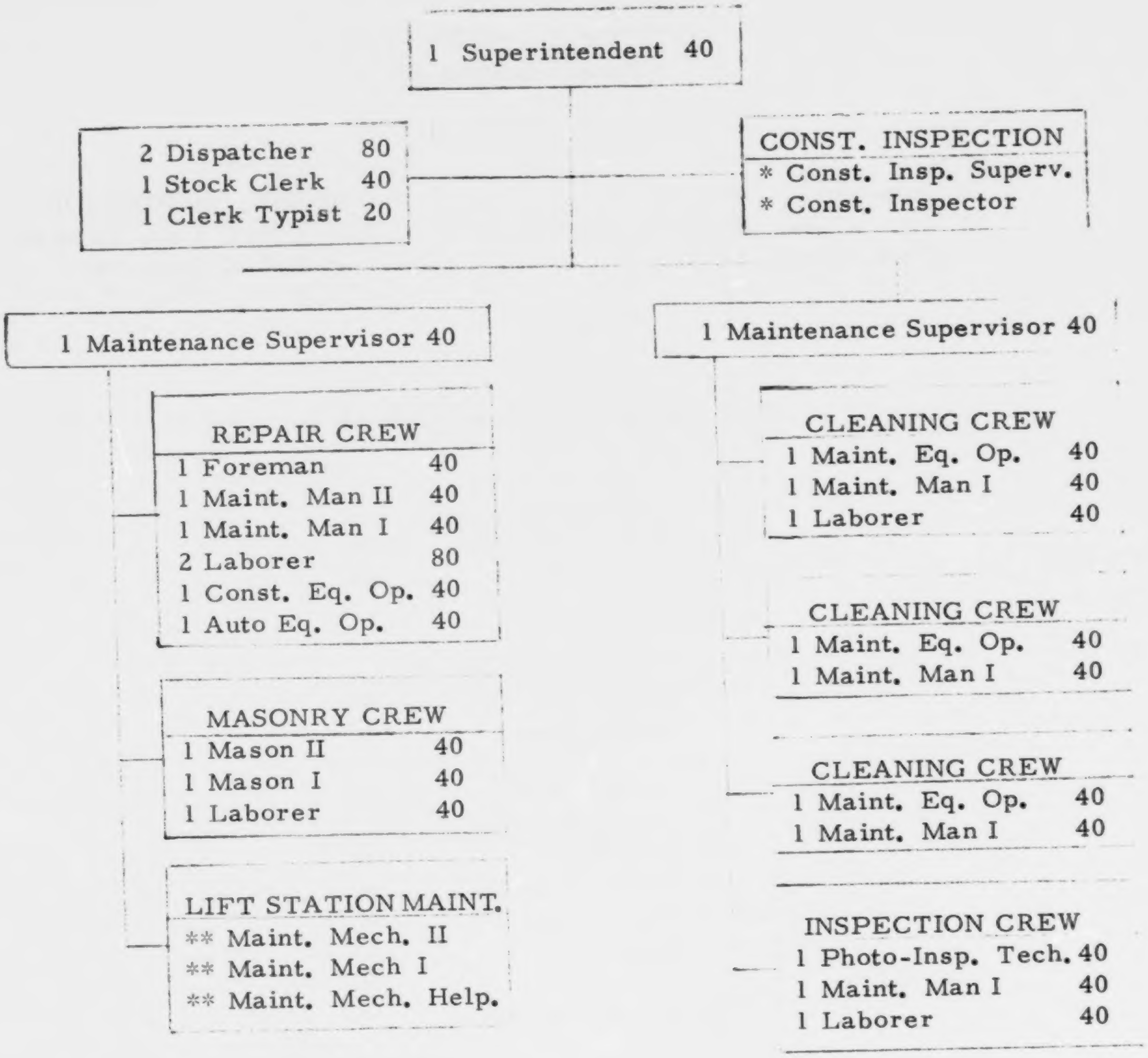

1 Superintendent 40
1 Dispatcher 40
1 Stock Clerk 40
1 Clerk Typist 20
CONST. INSPECTION
* Const. Insp. Superv.
* Const. Inspector
1 Maintenance Supervisor 40
CLEANING CREW
1 Maint. Eq. Op. 40
1 Maint. Man I 40
CLEANING CREW
1 Maint. Eq. Op. 40
1 Maint. Man I 40
REPAIR CREW
1 Foreman 40
1 Maint. Man II 40
1 Maint. Man I 40
1 Mason II 40
2 Laborer 80
1 Const. Eq. Op. 40
LIFT STATION MAINT.
** Maint. Mech. II
** Maint. Mech. I
** Maint. Mech. Helper

* Determined by time length of construction projects.
** Determined by number of lift stations.

CITY POPULATION: 50,000
(see pages 16-19 for explanations)

FIGURE 8

TYPICAL ORGANIZATION CHART FOR WASTEWATER COLLECTION SYSTEM
(in man-hours per week)

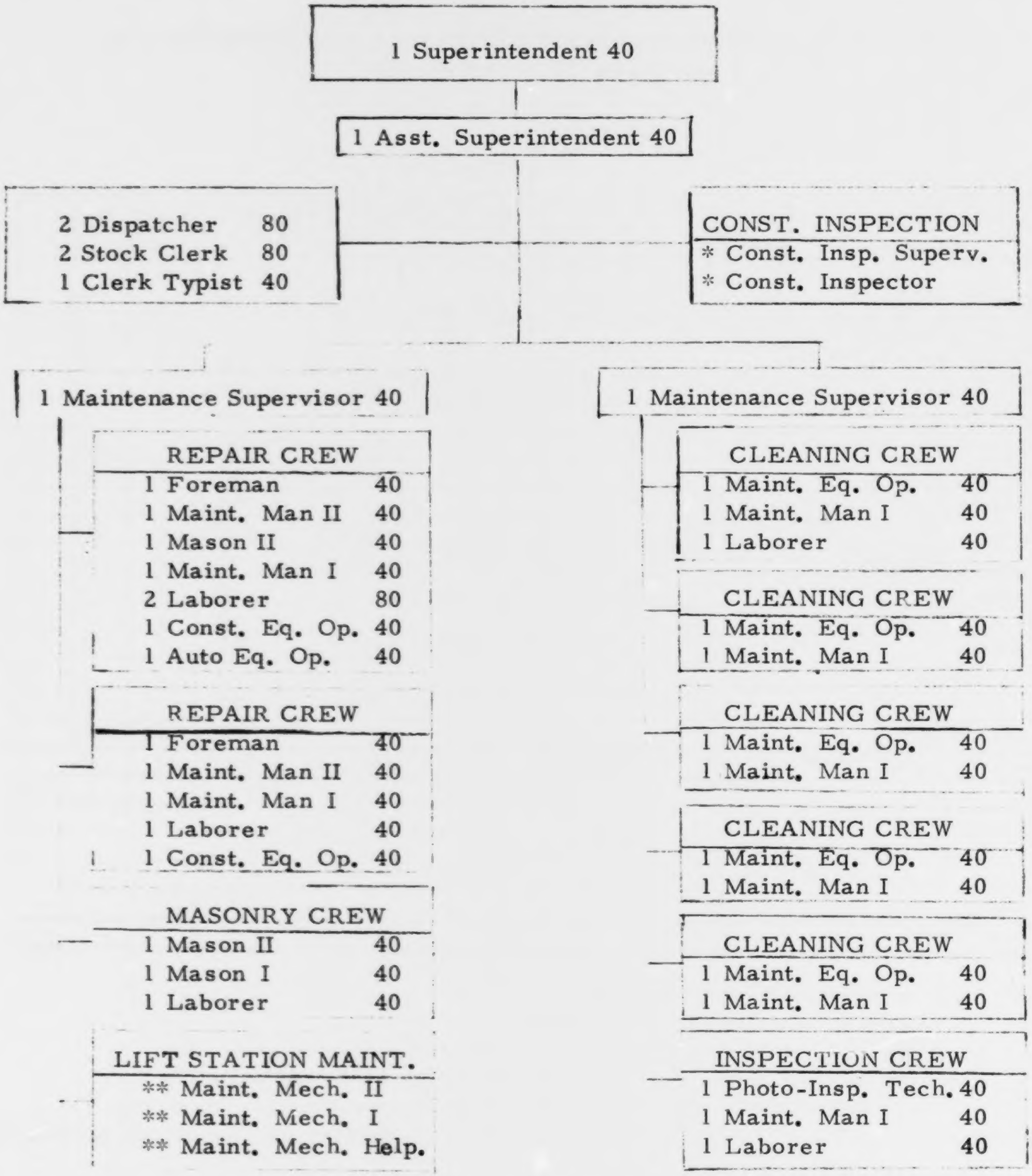

1 Superintendent 40
2 Dispatcher 80
1 Stock Clerk 40
1 Clerk Typist 20
CONST. INSPECTION
* Const. Insp. Superv.
* Const. Inspector
1 Maintenance Supervisor 40
REPAIR CREW
1 Foreman 40
1 Maint. Man II 40
1 Maint. Man I 40
2 Laborer 80
1 Const. Eq. Op. 40
1 Auto Eq. Op. 40
MASONRY CREW
1 Mason II 40
1 Mason I 40
1 Laborer 40
LIFT STATION MAINT.
** Maint. Mech. II
** Maint. Mech I
** Maint. Mech. Help.
1 Maintenance Supervisor 40
CLEANING CREW
1 Maint. Eq. Op. 40
1 Maint. Man I 40
1 Laborer 40
CLEANING CREW
1 Maint. Eq. Op. 40
1 Maint. Man I 40
CLEANING CREW
1 Maint. Eq. Op. 40
1 Maint. Man I 40
INSPECTION CREW
1 Photo-Insp. Tech. 40
1 Maint. Man I 40
1 Laborer 40

* Determined by time length of construction projects.
** Determined by number of lift stations.

CITY POPULATION: 100,000
(see pages 16-19 for explanations)

FIGURE 9

TYPICAL ORGANIZATION CHART FOR WASTEWATER COLLECTION SYSTEM
(in man-hours per week)



1 Superintendent 40

1 Asst. Superintendent 40

2 Dispatcher	80
2 Stock Clerk	80
1 Clerk Typist	40

CONST. INSPECTION
* Const. Insp. Superv.
* Const. Inspector

1 Maintenance Supervisor 40

REPAIR CREW	
1 Foreman	40
1 Maint. Man II	40
1 Mason II	40
1 Maint. Man I	40
2 Laborer	80
1 Const. Eq. Op.	40
1 Auto Eq. Op.	40

REPAIR CREW	
1 Foreman	40
1 Maint. Man II	40
1 Maint. Man I	40
1 Laborer	40
1 Const. Eq. Op.	40

MASONRY CREW	
1 Mason II	40
1 Mason I	40
1 Laborer	40

LIFT STATION MAINT.
** Maint. Mech. II
** Maint. Mech. I
** Maint. Mech. Help.

1 Maintenance Supervisor 40

CLEANING CREW	
1 Maint. Eq. Op.	40
1 Maint. Man I	40
1 Laborer	40

CLEANING CREW	
1 Maint. Eq. Op.	40
1 Maint. Man I	40

CLEANING CREW	
1 Maint. Eq. Op.	40
1 Maint. Man I	40

CLEANING CREW	
1 Maint. Eq. Op.	40
1 Maint. Man I	40

CLEANING CREW	
1 Maint. Eq. Op.	40
1 Maint. Man I	40

INSPECTION CREW	
1 Photo-Insp. Tech.	40
1 Maint. Man I	40
1 Laborer	40

* Determined by time length of construction projects.
** Determined by number of lift stations.

CITY POPULATION: 150,000
(see pages 16-19 for explanations)

FIGURE 10

TABLE I

STAFF COMPLEMENTS FOR WASTEWATER COLLECTION SYSTEM

(see pages 16-25 for details)

POPULATION SIZE

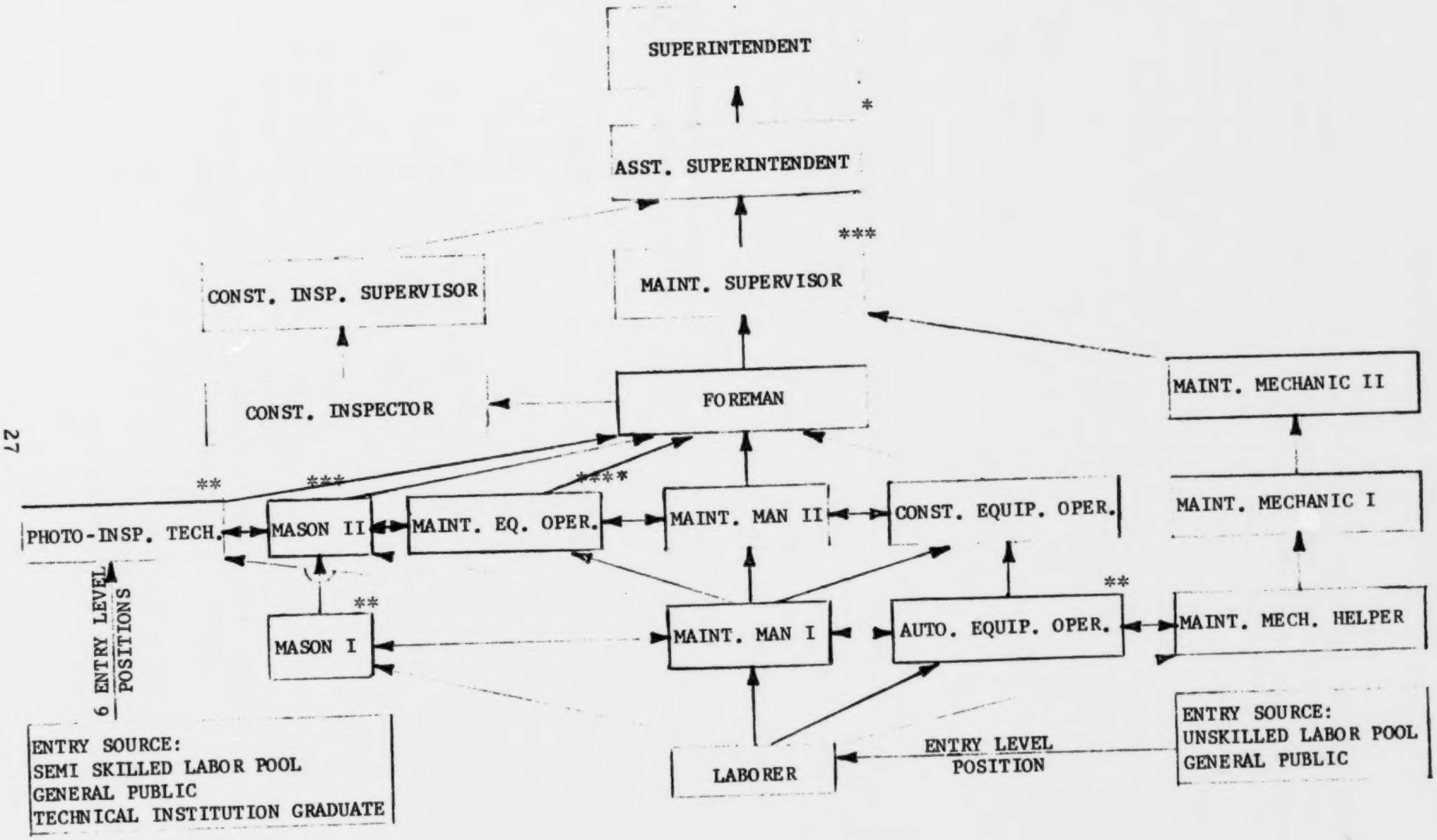
Occupational Title	5,000		10,000		25,000		50,000		100,000		150,000	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Superintendent	1	5	1	10	1	20	1	40	1	40	1	40
Asst. Superint.											1	40
Maint. Supervisor							1	40	2	80	2	80
Foreman	1	15	1	20	1	20	1	40	1	40	2	80
Maint. Man II	1	15	1	20	1	20	1	40	1	40	2	80
Maint. Man I	1	15	1	20	2	60	3	120	5	200	8	320
Mason II							1	40	1	40	2	80
Mason I									1	40	1	40
Maint. Eq. Op.					1	40	2	80	3	120	5	200
Const. Eq. Op.	1	15	1	20	1	20	1	40	1	40	2	80
Auto. Eq. Op.									1	40	1	40
Photo. Insp. Tech.									1	40	1	40
Laborer	1	15	1	20	2	40	2	80	5	200	6	240
Dispatcher							1	40	2	80	2	80
Clerk Typist							1	20	1	20	2	80
Stock Clerk							1	40	1	40	1	40
Sewer Maint. Staff	6	80	6	110	9	220	16	620	27	1060	39	1560
M. Mech. II (c)												
M. Mech. I (d)												
M. Mech. Help. (d)												
Const. Insp. (e)												
Const. Insp. S. (f)												
Total Staff												

(a) Estimated number of personnel.
(b) Estimated total man-hours per week.
(c) Multiply number of lift stations maintained by 8/3 (see page 17).
(d) Multiply number of lift station visits per week by 1 (see page 17).
(e) Multiply estimated construction site visits per week by 8/3 (see page 17).
(f) Determined by the number of Construction Inspectors employed and developed on a judgmental basis.

Unit processes included in this Staffing Table are:

1. Maintenance of Sanitary sewer main lines and appurtenances (laterals are not included). See first paragraph on page 18 for maintenance of laterals.
2. Maintenance of Storm sewer main lines.
3. Maintenance of lift stations.
4. Inspection of newly constructed sewer main lines and appurtenances.

CAREER LATTICE FOR A WASTEWATER COLLECTION SYSTEM


SUPERINTENDENT
*
ASST. SUPERINTENDENT
***
MAINT. SUPERVISOR
CONST. INSP. SUPERVISOR
CONST. INSPECTOR
FOREMAN
MAINT. MECHANIC II
MAINT. MECHANIC I
**
PHOTO-INSP. TECH.
***
MASON II
****
MAINT. EQ. OPER.
MAINT. MAN II
CONST. EQUIP. OPER.
**
MASON I
MAINT. MAN I
**
AUTO. EQUIP. OPER.
MAINT. MECH. HELPER
6 ENTRY LEVEL POSITIONS
ENTRY SOURCE: SEMI SKILLED LABOR POOL GENERAL PUBLIC TECHNICAL INSTITUTION GRADUATE
LABORER
ENTRY LEVEL POSITION
ENTRY SOURCE: UNSKILLED LABOR POOL GENERAL PUBLIC

* Position available only in system over 100,000 in population.
** Position available only in system over 50,000 in population.
*** Position available only in system over 25,000 in population.
**** Position available only in system over 10,000 in population.

4. OCCUPATIONAL DESCRIPTIONS

The objective of an Occupational Description is to portray the responsibilities, skills and knowledge required for the successful execution of identified tasks by the average worker. Such information is indispensable to provide the basis for the recruitment, selection, training, certification, placement and promotion of wastewater personnel. An Occupational Description presents an actual picture of the job by showing what the worker does, how he does it, why he does it, the skill involved, and the machine, tools, equipment and work aids used in performing his duties. It also indicates the Qualifications Profiles the employee should possess by specifying Formal Education, General Requirements, and Worker Traits such as General Educational Development, Specific Vocational Preparation, Aptitudes, Interests, Temperament, Physical Demands, and Working Conditions. Appendix 3 provides Worker Traits definitions prepared by the U.S. Department of Labor to explain job analysis specifications used in the Dictionary of Occupational Titles.

The twenty-one Occupational Descriptions presented in this chapter were developed on the basis of field observations and interviews with wastewater collection personnel in fifty-four cities in twelve states and formal reviews with analysts at the Department of Labor's Occupational Analysis Center in Raleigh, N.C. Survey instruments used are explained in the "Research Report" submitted in conjunction with this Manpower Manual (see note on page 3).

Detailed Occupational Descriptions for the following twenty-one types of personnel commonly employed in wastewater collection systems are presented on pages 30 through 83.

Occupational Descriptions	Page
1. Superintendent	30
2. Assistant Superintendent	33
3. Maintenance Supervisor	36
4. Foreman	39
5. Maintenance Man II	42
6. Maintenance Man I	45
7. Mason II	48
8. Mason I	51
9. Maintenance Equipment Operator	53
10. Construction Equipment Operator	56
11. Automotive Equipment Operator	58
12. Photo-Inspection Technician	60
13. Laborer	63
14. Maintenance Mechanic II	65
15. Maintenance Mechanic I	67
16. Maintenance Mechanic Helper	69

Occupational Descriptions Page

17. Construction Inspector Supervisor 71
18. Construction Inspector 74
19. Dispatcher 77
20. Stock Clerk 79
21. Clerk Typist 81

OCCUPATIONAL DESCRIPTION

Title: SUPERINTENDENT, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Supervises and coordinates, through subordinates, activities of workers engaged in construction and maintenance of storm and sanitary sewers and related structures. Compiles and analyzes records on manpower, material and equipment utilization, and initiates actions to improve work efficiency. Establishes, reviews and recommends departmental policies regarding work methods and safety procedures. Submits recommendations for expansion of sewerage system and acquisition of new equipment. Periodically visits work sites to ensure that correct, efficient and safe work procedures are followed according to established standards. Gives technical assistance to subordinates. Prepares and submits budget recommendations and reports for official records. Approves procurement of supplies and equipment. Confers with municipal authorities and state government officials to discuss adequacy of existing facilities. Cooperates with other city departments to coordinate efforts in improving standard of service and enforcing city plumbing codes and sewer ordinances. Confers with city engineers and contractors to discuss expansion of existing facilities.

QUALIFICATIONS PROFILE

1. Formal Education:
   Graduation from a high school is the minimum requirement, preferably supplemented by college level courses in civil or sanitary engineering. A college degree is highly desirable.

2. General Requirements:
   a. Knowledge of the principles, practices and techniques of sewer construction, repair and maintenance.
   b. Knowledge of tools, equipment and materials used in wastewater collection operations.
   c. Ability to organize, coordinate and evaluate the work of subordinates.
   d. Ability to prepare written reports and budgets and maintain work records.
   e. Ability to read and interpret blueprints, diagrams and specifications.
   f. Ability to establish and maintain effective working relationships with city officials, employees, contractors and the general public.

Title: SUPERINTENDENT (Cont'd)

3. General Educational Development:
   a. Reasoning:
      (1) Apply principles of logical thinking to define problems, collect data, establish facts, and draw valid conclusions.
      (2) Interpret an extensive variety of technical instructions in books, manuals, and mathematical or diagrammatic form.
      (3) Deal with several abstract and concrete variables.
   b. Mathematical:
      Perform ordinary arithmetic, algebraic, and geometric procedures in standard, practical applications.
   c. Language:
      (1) Prepare budgets, records, and reports.
      (2) Confer with subordinates, city officials, and the general public.
      (3) Evaluate engineering and technical data and interpret specifications.

4. Specific Vocational Preparation:
   Six to eight years of progressively responsible experience in wastewater collection activities, including at least three years of supervisory experience.

5. Aptitudes-Relative to General Working Population:

a.	Intelligence:	Highest third excluding top 10%
b.	Verbal:	"
c.	Numerical:	"
d.	Spatial:	"
e.	Form Perception:	Lowest third excluding bottom 10%
f.	Clerical Perception:	Middle third
g.	Motor Coordination:	Lowest third excluding bottom 10%
h.	Finger Dexterity:	"
i.	Manual Dexterity:	"
j.	Eye-Hand-Foot Coordination:	"
k.	Color Discrimination:	Lowest 10%

6. Interests:
   Preference for activities involving business contact with people and activities resulting in prestige or the esteem of others.

7. Temperament:
   Must adjust to a variety of tasks requiring frequent change and satisfactory working relationships with people. Must adjust to planning and controlling work activities.

Title: SUPERINTENDENT (Cont'd)

8. Physical Demands:
Sedentary work.

9. Working Conditions:
Inside work.

ENTRY SOURCES:	Assistant Superintendent, Maintenance Supervisor, Foreman, or Superintendent of a smaller system.
PROGRESSION TO:	Director of Public Works, Water and Sewer Administrator, or a smaller position in a larger or more complex system.

OCCUPATIONAL DESCRIPTION

Title: ASSISTANT SUPERINTENDENT, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Assists SUPERINTENDENT in coordinating functions of wastewater collection system to provide sewerage services with minimum interruption: Compiles data, analyzes maintenance records, and helps prepare recommendations dealing with utilization of resources, safety and work procedures, selection of new equipment, and expansion of existing facilities. Drives pickup truck to visit job sites to ensure compliance with established standards. Assists in planning and conducting safety and training programs. Assists in preparing annual budgets. Confers with contractors and equipment manufactureres to discuss bid specifications and requisitions of necessary equipment. Maintains personnel records and recommends promotions and pay raises. Serves as SUPERINTENDENT in his absence.

QUALIFICATIONS PROFILE

1. Formal Education:
   Graduation from a high school is the minimum requirement, preferably supplemented by college level courses in civil or sanitary engineering. A college degree is highly desirable.

2. General Requirements:
   - a. Knowledge of the principles, practices and techniques of sewer construction, repair and maintenance.
   - b. Knowledge of tools, equipment, and materials used in wastewater collection operations.
   - c. Knowledge of city sewer and drain system.
   - d. Knowledge of occupational hazards and ability to enforce safety precautions.
   - e. Ability to assign and supervise work of subordinates and to train them in proper work techniques.
   - f. Ability to prepare written reports and budgets and maintain work records.
   - g. Ability to establish and maintain effective working relationships with city officials, employees, contractors and the general public.

3. General Educational Development:
   a. Reasoning:
      (1) Apply principles of logical thinking to define problems, collect data, and draw valid conclusions.
      (2) Interpret an extensive variety of technical instructions, in books, manuals, mathematical or diagrammatic form.
      (3) Deal with several abstract and concrete variables.
   b. Mathematical:
      Perform ordinary arithmetic, algebraic and geometric procedures in standard, practical applications.
   c. Language:
      (1) Write and edit reports and records.
      (2) Analyze and evaluate technical data.
      (3) Confer with employees, city officials and the public.

4. Specific Vocational Preparation:
   Four to six years of progressively responsible experience in wastewater collection work, including at least two years of supervisory experience.

5. Aptitudes-Relative to General Working Population:

a.	Intelligence:	Highest third excluding top 10%
b.	Verbal:	"
c.	Numerical:	"
d.	Spatial:	"
e.	Form Perception:	Middle third
f.	Clerical Perception:	"
g.	Motor Coordination:	Lowest third excluding bottom 10%
h.	Finger Dexterity:	"
i.	Manual Dexterity:	"
j.	Eye-Hand-Foot Coordination:	"
k.	Color Discrimination:	Lowest 10%

6. Interests:
   Interest in activities involving business contact with people and resulting in prestige or the esteem of others.

7. Temperament:
   Must adjust to planning and controlling a variety of work activities requiring frequent change. Must have satisfactory working relationships with people.

8. Physical Demands:
   Sedentary work involving periodic inspection of work sites.

Title: ASSISTANT SUPERINTENDENT (Cont'd)

9. Working Conditions:
Work is performed both inside and outside.

ENTRY SOURCES: Maintenance Supervisor or Foreman.

PROGRESSION TO: Superintendent or a similar position in a larger or more complex system.

OCCUPATIONAL DESCRIPTION

Title: MAINTENANCE SUPERVISOR, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Coordinates and supervises work crews engaged in repairing, cleaning, and maintaining storm and sanitary sewer lines: Confers with SUPERINTENDENT or ASSISTANT SUPERINTENDENT to discuss job assignments, schedule work and equipment for crews, and evaluate workers. Determines priority of work orders received, evaluates most feasible approaches, assigns tasks to crews, and ensures that needed materials and equipment are provided. Drives truck to job sites to inspect periodically and evaluate work in progress to assure that correct, efficient and safe work procedures are followed according to accepted standards. Provides technical assistance and direct supervision as needed for efficient operation. Directs activities that are regarded complex enough to demand high responsibility. Inspects and evaluates completed jobs to determine conformance to specifications and work orders. Gives directions to and meets with FOREMEN, MAINTENANCE MEN II, and EQUIPMENT OPERATORS to assign work and to discuss and prescribe work methods. Reads maps and blueprints. Plans sewer preventive maintenance activities and schedules routine cleaning of sewerage system with sewer cleaning equipment. Checks equipment used by crews to make sure that equipment functions properly and is adequately maintained. Keeps records, makes reports, and recommends improvements in work methods and standard of service. Checks time slips, sick leave, and arranges vacation time. Trains and instructs subordinates.

QUALIFICATIONS PROFILE

1. Formal Education:
   Minimum requirement usually is high school or vocational school graduation.

2. General Requirements:
   a. Knowledge of work methods, tools, equipment, and materials used in the construction, repair, and maintenance of sanitary and storm sewers, and related structures.
   b. Knowledge of city sewer and drain system.
   c. Knowledge of work hazards and ability to enforce safety precautions.
   d. Ability to plan, supervise, and coordinate preventive maintenance and repair activities, and evaluate their effectiveness.

Title: MAINTENANCE SUPERVISOR (Cont'd)

e. Ability to read and interpret blueprints, diagrams, and specifications.
f. Ability to establish and maintain effective working relationships with employees and general public.

3. General Educational Development:
   a. Reasoning:
      (1) Apply principles of wastewater collection system to solve practical problems and deal with a variety of concrete variables in situations where only limited standardization exists.
      (2) Interpret a variety of instructions furnished in written, oral, diagrammatic or schedule form.
   b. Mathematical:
      Perform ordinary arithmetic, algebraic, and geometric procedures in standard, and practical applications.
   c. Language:
      (1) Confer with superiors and subordinates and interview job applicants.
      (2) Interpret technical manuals, specifications, sewer maps, and blueprints.
      (3) Writes maintenance reports.

4. Specific Vocational Preparation:
   Four years experience in sewer maintenance and construction work including two years experience as a FOREMAN, MAINTENANCE MAN II, or MAINTENANCE EQUIPMENT OPERATOR.

5. Aptitudes-Relative to General Working Population:

a. Intelligence:	Middle third
b. Verbal:	"
c. Numerical:	"
d. Spatial:	"
e. Form Perception:	"
f. Clerical Perception:	Lowest third excluding bottom 10%
g. Motor Coordination:	Middle third
h. Finger Dexterity:	"
i. Manual Dexterity:	"
j. Eye-Hand-Foot Coordination:	"
k. Color Discrimination:	Lowest third excluding bottom 10%

6. Interests:
   An interest in activities concerned with machines and techniques, and resulting in prestige or the esteem of others.

Title: MAINTENANCE SUPERVISOR (Cont'd)

7. Temperament:
   Must adjust to situations involving the direction, control, and planning of a variety of activities requiring frequent change. Must also have satisfactory working relationships with people beyond giving and receiving instructions.

8. Physical Demands:
   Work is light, involving talking, hearing, seeing, and occasional reaching, handling, fingering, and feeling.

9. Working Conditions:
   Work is performed largely outside and involves noise from operation of equipment, and occasional contact with water. Exposed to weather and occasionally noxious smells.

ENTRY SOURCES: Foreman, Maintenance Man II or Maintenance Equipment Operator.

PROGRESSION TO: Assistant Superintendent or Superintendent.

OCCUPATIONAL DESCRIPTION

Title: FOREMAN, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Supervises and coordinates activities of medium to large size crew engaged in the repair and minor construction of storm and sanitary sewers, and appurtenances: Assigns tasks to MAINTENANCE MEN, LABORERS, and AUTOMOTIVE EQUIPMENT OPERATORS involved in repairing and constructing sewer lines, manholes, catch basins and drainage facilities. Confers with MAINTENANCE SUPERVISOR to receive job assignments. Reads maps and interprets sketches and blueprints to determine location of job sites, existing utilities lines, and city right-of-way limits. Provides technical assistance and prescribes work methods and safety procedures to workers. Directs AUTOMOTIVE EQUIPMENT OPERATORS in excavating and backfilling trenches. Directs MAINTENANCE MEN and LABORERS in breaking asphalt or pavement. Examines sewer lines to determine cause of malfunction and need for repair and decides on corrective action to take. Oversees work in progress to assure conformance to job specifications and enforcement of safety precautions. Supervises laying and joining of sewer lines and ensures that joints are tight and sealed properly before backfilling. Requisitions delivery and oversees removal of materials such as stone, dirt, and broken pavement. Prepares records showing actions taken, manpower and equipment utilization, and disposition of material. Requisitions tools and equipment. Drives pickup truck to and from work sites. Communicates with MAINTENANCE SUPERVISOR and DISPATCHER, using radio telephone. Gives directions to subordinates, trains them in safety procedures and work methods, and evaluates their work.

QUALIFICATIONS PROFILE

1. Formal Education:
   Graduation from a high school or vocational school.

2. General Requirements:
   a. Knowledge of methods, equipment, and materials used in sewer installation, repair and maintenance.
   b. Knowledge of occupational hazards and safety precautions of work.
   c. Knowledge of city streets and sewerage system.
   d. Ability to supervise and coordinate the work of subordinates and to instruct them in proper work methods and procedures.
   e. Ability to read simple diagrams, profiles, specifications, and blueprints.
   f. Ability to carry out and transmit oral and written instructions.

Title: FOREMAN (Cont'd)

3. General Educational Development:
    a. Reasoning:
        (1) Apply principles of wastewater collection system to solve practical problems and deal with a variety of concrete variables in situations where only limited standardization exists.
        (2) Interpret a variety of instructions furnished in written, oral, or diagrammatic form.
    b. Mathematical:
        Perform ordinary arithmetic, algebraic, and geometric procedures in standard, practical applications.
    c. Language:
        (1) Interview job applicants, direct, and instruct employees.
        (2) Prepare various operating reports.
        (3) Read and interpret sketches, blueprints, and diagrams.

4. Specific Vocational Preparation:
    A minimum of four years of experience in the field of sewer maintenance and construction work, including at least two years experience as a lead man.

5. Aptitudes-Relative to General Working Population:
    a. Intelligence: Middle third
    b. Verbal: "
    c. Numerical: "
    d. Spatial: "
    e. Form Perception: "
    f. Clerical Perception: Lowest third excluding bottom 10%
    g. Motor Coordination: Middle third
    h. Finger Dexterity: "
    i. Manual Dexterity: "
    j. Eye-Hand-Foot Coordination: Lowest third excluding bottom 10%
    k. Color Discrimination: "

6. Interests:
    A preference for activities resulting in prestige or the esteem of others and for activities concerned with machines and processes.

7. Temperament:
    Must adjust to planning and controlling a variety of tasks requiring frequent change.

8. Physical Demands:
    Medium work, involving climbing, balancing, stooping, kneeling, crouching, reaching, handling, talking, and seeing.

Title: FOREMAN (Cont'd)

9. Working Conditions:
   Work is performed outside. Exposed to weather, noise, risk of bodily injury, and occasionally to dust and noxious smells.

ENTRY SOURCES: Maintenance Man II, Maintenance Equipment Operator, or Construction Equipment Operator.

PROGRESSION TO: Maintenance Supervisor, Assistant Superintendent, or Superintendent, depending on the size of the system.

OCCUPATIONAL DESCRIPTION

Title: MAINTENANCE MAN II, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Repairs and maintains municipal storm and sanitary sewer lines, functioning as leadman and performing any combination of following tasks: Inspects manholes to determine location of stoppage. Runs rods through rod guide, fits front end of rod with auger, using wrench, and lowers guide into position. Thrusts rods into invert and advances them until auger reaches obstruction. Rotates rods manually with turning pin or attaches end of rod to portable power rodder to rotate rods. Pulls lever and depresses pedal of machine to advance cleaning tool slowly until it encounters obstruction and to rotate cable or rods until obstacle is broken. Retracts rods to drag out obstructions such as roots, grease, and other deposits. Cleans and repairs catch basins, manholes, culverts and storm drains, using hand tools. Raises manhole walls to prescribed street level, using masonry tools. Measures distance of excavation site, using tape measure, and marks outline of area to be trenched according to direction of FOREMAN. Breaks asphalt and other pavement, using air hammer, pick and shovel. Cuts damaged section of pipe with cutters and removes broken section from ditch. Replaces broken pipes and reconnects pipe sections, using pipe sleeve. Inspects joints to ensure they are tight and sealed properly before backfilling. Packs backfilled excavation, using air and gasoline tamper. Taps mainline sewers to install sewer saddles. Replaces manhole covers. Updates sewer maps and manhole charting. Drives pickup truck to haul crew, materials and equipment. Services, adjusts and makes minor repairs to equipment, machines, and attachments. Communicates with DISPATCHER, FOREMAN, MAINTENANCE SUPERVISOR, and others, using radio telephone. Gives directions to MAINTENANCE MEN I, and LABORERS, instructs them in efficient and safe use of machines, trains them in work methods, and ensures that proper procedures and safety precautions are followed. Prepares records showing actions taken, manpower and equipment utilization, and disposition of material. Requisitions tools and equipment. May operate sewer cleaning equipment including power rodder, high velocity water jet, sewer flusher, bucket machine, wayne ball, and vac-all. May clean and disinfect domestic basements and other areas flooded as a result of sewer stoppages. May act as leadman in a large repair and construction crew under the supervision of a FOREMAN.

Title: MAINTENANCE MAN II (Cont'd)

QUALIFICATIONS PROFILE

1. Formal Education:
   Usually required to have completed eighth grade. Completion of tenth grade or graduation from high school or vocational school is highly desirable and is increasingly required.

2. General Requirements:
   a. Knowledge of methods, tools, equipment, and materials used in sewer construction, repair, and maintenance.
   b. Knowledge of lay out of city streets and locations of sewer lines and related structures.
   c. Knowledge of work hazards and applicable safety precautions.
   d. Ability to locate, detect, and correct sewer stoppages and leaks.
   e. Ability to lead the work of a small crew.
   f. Ability to establish and maintain effective working relationships with employees and the general public.
   g. Possession of a valid driver's license.

3. General Educational Development:
   a. Reasoning:
      (1) Apply common sense understanding to carry out instructions furnished in oral, written or diagrammatic form.
      (2) Deal with problems involving several concrete variables in or from standardized situations.
   b. Mathematical:
      Make arithmetic calculations involving fractions, decimals, and percentages.
   c. Language:
      (1) Communicate with fellow employees and train subordinates in work methods.
      (2) Fill in maintenance report forms.

4. Specific Vocational Preparation:
   Three years experience in the repair and maintenance of sewerage system is commonly required.

5. Aptitudes-Relative to General Working Population:

a.	Intelligence:	Middle third
b.	Verbal:	"
c.	Numerical:	"
d.	Spatial:	Highest third excluding top 10%
e.	Form Perception:	Middle third

Title: MAINTENANCE MAN II (Cont'd)

f. Clerical Perception: Lowest third excluding bottom 10%
g. Motor Coordination: Middle third
h. Finger Dexterity: "
i. Manual Dexterity: "
j. Eye-Hand-Foot Coordination: Lowest third excluding bottom 10%
k. Color Discrimination: "

6. Interests:
An interest in activities concerned with things, objects, machines, and techniques.

7. Temperament:
Must adjust to a variety of tasks requiring frequent change and adhere closely to established standards and procedures. Must adjust to making judgmental decisions.

8. Physical Demands:
Medium to heavy work involving lifting, climbing, stooping, kneeling, crouching, crawling, reaching, handling, fingering, talking, hearing, and seeing.

9. Working Conditions:
The work is outside and involves wet conditions, noise, risk of bodily injury, and exposure to weather, noxious smells, and gases.

ENTRY SOURCES: Mason II, Maintenance Man I, or General Public.

PROGRESSION TO: Foreman, or Maintenance Supervisor.

OCCUPATIONAL DESCRIPTION

Title: MAINTENANCE MAN I, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Assists MAINTENANCE MAN II, and MAINTENANCE EQUIPMENT OPERATOR in the repair, construction, and maintenance of storm and sanitary sewers and related structures, performing any combination of following tasks: Breaks asphalt and other pavement, using air hammer, pick, and shovel. Assists in bracing and shoring excavations, cutting, fitting, laying, joining, and caulking sewer lines, coupling and sealing pipe joints, and in making sewer taps. Assists in building manholes and catch basins and in raising and lowering manhole walls. Chips away concrete along cracks of manholes, to prepare for repairs, using hammer and chisel. Knocks rim off manholes and breaks top of manhole wall, using sledge hammer. Mixes cement, sand and water, to prepare mortar, using shovel. Removes debris such as sticks, rags, rocks, sand, grease, and other foreign matter from bottom of manholes, using long handled shovel, long hook, spoon, fork or rod; and raises deposits to surface and dumps them into truck to be hauled away for disposition. Examines condition of lines, manholes, and inverts and informs supervisor if damage is detected. Climbs into manhole and places mirror near invert to reflect sunlight into sewer (from mirror held by other worker on surface) to determine condition of sewer line. Cuts trees, branches, bushes, and shrubs, using chainsaw and axe. Assists in unclogging storm and sanitary sewer lines by hand or using machine-driven tool. Attaches bit to end of cable, using wrench, and inserts cable into line to remove stoppage. Connects fill hose of high velocity water jet to fire hydrant and turns water on to fill water tank of water jet to prescribed level, using hydrant wrench. Inserts nozzle of hose down manhole through roller guide into main line. Places sandtrap in lower manhole to catch wayne ball and debris. Assists in setting up power winch of bucket machine over manholes. Activates power winch and disengages gear to move bucket in line. Attaches auger to end of rod, using wrench. Lowers rod guide and pipe jack into manhole. Observes footage gauge, turns handle of cable stand manually to advance camera through sewer line, signals PHOTO-INSPECTION TECHNICIAN to snap pictures every four feet, and records distances traveled by camera on schedule sheet. Observes and moves cable and rope while standing in manhole to move camera through sewer line without damage. Assists in servicing equipment, machines, and attachments. Conveys materials and tools about job site. Cleans work sites, removes debris, and places tools in truck after completion of job. Erects barricades or traffic cones to protect workmen and public. May drive pickup truck.

Title: MAINTENANCE MAN I (Cont'd)

QUALIFICATIONS PROFILE

1. Formal Education:
   Minimum requirement is the completion of eighth grade. A high school or vocational school is highly desirable. Must be able to read and write.

2. General Requirements:
   a. Knowledge of the uses of sewer construction and maintenance tools and equipment.
   b. Knowledge of occupational hazards and necessary safety precautions.
   c. Ability to understand and follow oral and written instructions.
   d. Ability to maintain working relationships with fellow employees and the public.
   e. Ability to perform heavy manual labor under varying weather conditions.
   f. Possession of a valid driver's license.

3. General Educational Development:
   a. Reasoning:
      Apply common sense understanding to carry out detailed but uninvolved written or oral instruction.
   b. Mathematical:
      Use arithmetic to add, subtract, multiply, and divide whole numbers.
   c. Language:
      Ability to understand and carry out instructions and to establish and maintain communication with fellow employees and supervisors.

4. Specific Vocational Preparation:
   Approximately six months of experience as a laborer in sewer construction and maintenance work.

5. Aptitudes-Relative to General Working Population:
   a. Intelligence: Lowest third excluding bottom 10%
   b. Verbal: "
   c. Numerical: "
   d. Spatial: "
   e. Form Perception: "
   f. Clerical Perception: "
   g. Motor Coordination: Middle third
   h. Finger Dexterity: "

Title: MAINTENANCE MAN I (Cont'd)

i. Manual Dexterity: Middle third
j. Eye-Hand-Foot Coordination: Lowest third excluding bottom 10%
k. Color Discrimination: "

6. Interests:
Preference for activities of concrete and organized nature dealing with things and objects.

7. Temperament:
Must adjust to situations involving doing things only under specific instructions and must have disposition to adhere exactly to established standards and procedures.

8. Physical Demands:
The work is heavy to very heavy and involves lifting heavy objects, climbing, stooping, kneeling, crouching, crawling, reaching, handling, fingering, talking, hearing, and seeing.

9. Working Conditions:
Work is outside and it involves exposure to weather, water, noise, noxious smells, gases, and the risk of bodily injury.

ENTRY SOURCES: Laborer, or General Public.

PROGRESSION TO: Maintenance Man II, Maintenance Equipment Operator, or Construction Equipment Operator.

OCCUPATIONAL DESCRIPTION

Title: MASON II, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Builds, repairs, and finishes sewer related structures such as manholes, culverts, catch basins, and retaining walls, using masonry tools, floats, trowels and screeds: Inspects masonry appurtenances to ascertain condition of structures and need for repairs. Raises or lowers manhole walls to conform with grade changes. Chips away concrete along cracks to prepare for repairs, using hammer and chisel. Knocks rim off manholes and breaks top of manhole walls, using sledge hammer. Replaces fallen bricks and patches cracks and erroded inverts with fresh mortar, using trowel. Presses bricks into cement mixture and lays them to specified levels. Smooths and finishes surfaces of concrete walls to specified textures, using floats. Places rim over brick and cements rim to ensure that cover is secure in place. Installs prefabricated manholes. Signals to CONSTRUCTION EQUIPMENT OPERATOR to align prefabricated manhole and press it into proper position. Applies mortar mix on area between pre-cast concrete and existing walls to secure manhole in position. Bypasses manholes to dewater them using pumps. Drives pickup truck to work sites to haul workers, materials, and equipment. Gives directions to MASON I, and LABORERS, instructs them in efficient and safe use of machines and tools, trains them in work methods, and ensures that proper procedures and safety precautions are followed. Requisitions tools and materials. May act as crew leader. May mix cement, sand, and water to prepare mortar, using shovel.

QUALIFICATIONS PROFILE

1. Formal Education:
   Usually required to have completed at least the eighth grade. Completion of the tenth grade or graduation from high school or vocational school is highly desirable.

2. General Requirements:
   a. Knowledge of materials, methods, and standard practices of the masonry trade.
   b. Knowledge of work hazards and applicable safety precautions.
   c. Ability to use effectively masonry tools.
   d. Ability to lead the work of a small crew.
   e. Ability to establish and maintain effective working relationships with employees and the general public.
   f. Possession of a valid driver's license.

Title: MASON II (Cont'd)

3. General Educational Development:
   a. Reasoning:
      (1) Apply common sense understanding to carry out instructions furnished in oral, written or diagrammatic form.
      (2) Deal with problems involving several concrete variables in or from standardized situations.
   b. Mathematical:
      Make arithmetic calculations involving fractions, decimals and percentages.
   c. Language:
      (1) Communicate with fellow employees and trains subordinates in work methods.
      (2) Fill in work report forms.

4. Specific Vocational Preparation:
   Two to three years experience in construction and masonry work.

5. Aptitudes-Relative to General Working Population:

a.	Intelligence:	Middle third
b.	Verbal:	Lowest third excluding bottom 10%
c.	Numerical:	"
d.	Spatial:	Middle third
e.	Form Perception:	"
f.	Clerical Perception:	Lowest third excluding bottom 10%
g.	Motor Coordination:	Middle third
h.	Finger Dexterity:	"
i.	Manual Dexterity:	"
j.	Eye-Hand-Foot Coordination:	Lowest third excluding bottom 10%
k.	Color Discrimination:	Lowest 10%

6. Interests:
   An interest in activities concerned with things, objects, machines, and techniques.

7. Temperament:
   Must adjust to situations involving repetitive operations carried out according to set procedures and must adhere to accepted standards.

8. Physical Demands:
   Medium to heavy work involving lifting , climbing, stooping, kneeling, crouching, crawling, reaching, handling, fingering, talking, hearing, and seeing.

Title: MASON II (Cont'd)

9. Working Conditions:
The work is outside and involves wet conditions, risk of bodily injury, and exposure to weather, noxious smells, and gases.

ENTRY SOURCES:	Mason I.
PROGRESSION TO:	Maintenance Man II, Foreman, or Maintenance Supervisor.

OCCUPATIONAL DESCRIPTION

Title: MASON I, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Assists MASON II to build, repair, and finish manholes, culverts, catch basins and other sewer-related appurtenances, using masonry tools such as floats, trowels, and screeds: Removes manhole covers, using pick. Inspects structures and relays to MASON II condition of structures. Chips away concrete along cracks to prepare for repairs, using hammer and chisel. Raises loose bricks and debris from bottom of manhole to surface and dumps them in truck, using bucket and shovel. Mixes cement, sand, and water to prepare mortar, using shovel. Deposits mortar on board within reach of MASON II. Assists in preparing, smoothing, and finishing surfaces of concrete walls to specified textures, using float. Assists in dewatering manholes to bypass them. Conveys and replaces tools on truck. May drive pickup truck to haul crew, materials, equipment, and tools. Performs other duties as directed by MASON II.

QUALIFICATIONS PROFILE

1. Formal Education:
   Minimum requirement is the completion of eighth grade. Graduation of a high school or a vocational school is highly desirable.

2. General Requirements:
   a. Knowledge of tools, equipment, and materials used in masonry work.
   b. Knowledge of work hazards and applicable safety precautions.
   c. Ability to understand and follow oral and written instructions.
   d. Ability to maintain working relationships with fellow employees and general public.
   e. Ability to perform heavy manual labor under varying weather conditions.
   f. Possession of a valid driver's license.

3. General Educational Development:
   a. Reasoning:
      Apply common sense understanding to carry out simple 1-or 2-step instructions.
   b. Mathematical:
      Perform simple addition and subtraction, reading and copying of figures, or counting and recording.

Title: MASON I (Cont'd)

c. Language:
Learn job duties from oral instructions or demonstration. Requests orally or in writing work supplies and materials.

4. Specific Vocational Preparation:
Approximately six months of experience as a laborer in masonry work.

5. Aptitude-Relative to General Working Population:
   - a. Intelligence: Lowest third excluding bottom 10%
   - b. Verbal: "
   - c. Numerical: Lowest 10%
   - d. Spatial: Lowest third excluding bottom 10%
   - e. Form Perception: "
   - f. Clerical Perception: Lowest 10%
   - g. Motor Coordination: Middle third
   - h. Finger Dexterity: Lowest third excluding bottom 10%
   - i. Manual Dexterity: Middle third
   - j. Eye-Hand-Foot Coordination: Lowest third excluding bottom 10%
   - k. Color Discrimination: Lowest 10%

6. Interests:
Preference for activities of concrete and organized nature dealing with things and objects.

7. Temperament:
Must adjust to situations involving repetitive operations carried out according to set procedures or sequences and involving doing things only under specific instruction with little or no room for independent action or judgment.

8. Physical Demands:
The work is heavy to very heavy and involves lifting, climbing, stooping, kneeling, crouching, reaching, handling, fingering, and seeing.

9. Working Conditions:
Work is outside and it involves exposure to weather, water, noxious smells, gases, and the risk of bodily injury.

ENTRY SOURCES: Laborer and General Public.

PROGRESSION TO: Mason II.

OCCUPATIONAL DESCRIPTION

Title: MAINTENANCE EQUIPMENT OPERATOR, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Operates maintenance equipment such as high velocity water jet, bucket machine, power rodder, vacuum jet rodder, wayne ball machine, and sewer flusher, to clean and unclog storm and sanitary sewer lines functioning as leadman and performing any combination of following tasks: Drives and positions equipment. Inserts nozzle of high velocity water jet hose down manhole through roller guide into mainline. Observes water pressure and footage gauges to ascertain length of hose in line and to determine when obstruction is met. Moves levers to direct movement of water jet hose in sewer line. Selects and attaches auger of specified size to rod, using wrench. Lowers rod guide and pipe jack into manhole using rope attachment. Starts machine and moves levers to advance cleaning tool in sewer line, to regulate rate of speed of rod, to rotate auger to bore through and loosen obstruction, and to withdraw rod. Sets up power winches of bucket machine over manholes. Floats rope attached to tow sack down to adjacent manhole to thread sewer line. Attaches cables from two power winches to bucket so bucket can move inside sewer line in both directions. Disengages upper winch out of gear and signals MAINTENANCE MAN I to activate lower power winch to close and retract bucket. Pulls bucket to surface and empties contents into truck. Places cable through jack pulley and attaches cable to wayne ball. Inserts wayne ball into sewer line. Directs MAINTENANCE MEN I to connect fire hose to fire hydrant and to turn fire hydrant on to build up water pressure in sewer line, to move ball that removes accumulated debris downstream. Inserts flushing truck water hose into manhole and turns water on to wash debris in line. Services, adjusts, and makes minor repairs to equipment and attachments. Communicates with DISPATCHER, FOREMAN, MAINTENANCE SUPERVISOR, using radio telephone. Gives directions to MAINTENANCE MEN I, and LABORERS, instructs them in the efficient and safe use of tools and machines, trains them in work methods and ensures that proper procedures and safety precautions are followed. Prepares daily reports showing manpower and equipment utilization, lines cleaned, and number of stoppages opened. May clean and disinfect domestic basements and other areas flooded as a result of sewer stoppages.

QUALIFICATIONS PROFILE

1. Formal Education:

   Minimum requirement is usually completion of eighth grade.

Title: MAINTENANCE EQUIPMENT OPERATOR (Cont'd)

Graduation from high school or vocational school is highly desirable and is increasingly required.

2. General Requirements:
    a. Knowledge of the operation, servicing, and minor repair of a variety of sewer cleaning equipment.
    b. Knowledge of methods, tools, and materials used to clean and unclog storm and sanitary sewer lines.
    c. Knowledge of lay out of city streets and locations of sewer lines and related structures.
    d. Knowledge of work hazards and applicable safety precautions.
    e. Ability to detect and perform minor repairs and adjustment to equipment.
    f. Ability to locate, detect, and correct sewer stoppages.
    g. Ability to lead the work of a small crew.
    h. Ability to establish and maintain effective working relationships with employees and the general public.
    i. Possession of a valid driver's license.

3. General Educational Development:
    a. Reasoning:
        (1) Apply common sense understanding to carry out instructions furnished in oral, written or diagrammatic form.
        (2) Deal with problems involving several concrete variables in or from standardized situations.
    b. Mathematical:
        Make arithmetic calculations involving fractions, decimals, and percentages.
    c. Language:
        (1) Communicate with fellow employees, and train subordinates in work methods.
        (2) Fill in maintenance report forms.

4. Specific Vocational Preparation:
    One to two years experience in sewer maintenance and equipment operation is required to achieve average performance and to lead a small crew. Length of training depends on educational background and mechanical attitude and is of the informal on-the-job-type.

5. Aptitudes-Relative to General Working Population:

a. Intelligence:	Middle third
b. Verbal:	Lowest third excluding bottom 10%
c. Numerical:	"

Title: MAINTENANCE EQUIPMENT OPERATOR (Cont'd)

d.	Spatial:	Middle third
e.	Form Perception:	Lowest third excluding bottom 10%
f.	Clerical Perception:	"
g.	Motor Coordination:	Middle third
h.	Finger Dexterity:	Lowest third excluding bottom 10%
i.	Manual Dexterity:	Middle third
j.	Eye-Hand-Foot Coordination:	"
k.	Color Discrimination:	Lowest third excluding bottom 10%

6. Interests:
   A preference for activities dealing with things, objects, machines, and techniques.

7. Temperament:
   Must adjust to situations involving repetitive operations carried out according to set procedures or sequences and must adhere to accepted standards. Must also adjust to situations requiring the evaluation of information against judgmental criteria.

8. Physical Demands:
   Medium work involving lifting, climbing, stooping, kneeling, crouching, reaching, handling, fingering, talking, hearing, and seeing.

9. Working Conditions:
   The work is outside and involves contact with water, risk of bodily injury, and exposure to weather, noise and noxious smells.

ENTRY SOURCES: Maintenance Man I.

PROGRESSION TO: Foreman, or Maintenance Supervisor.

OCCUPATIONAL DESCRIPTION

Title: CONSTRUCTION EQUIPMENT OPERATOR, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Operates variety of construction and earth moving equipment to assist in sewer repair and construction: Moves hand and foot levers to operate such equipment as back hoe, front end loader, dragline, bulldozer, motor grader and trenching machine to load, unload, and haul gravel, rock, dirt, sand, equipment, and materials; Excavate and backfill trenches; Position pre-cast manholes, storm and sanitary pipes; Move and level ground to desired grade. Performs related construction duties. Observes signals of another worker to facilitate positioning and operation of equipment. Services, adjusts and makes minor repairs to equipment. Works under the supervision of a FOREMAN or a crew leader. May be designated according to type of machine operated as BACK HOE OPERATOR, DRAGLINE OPERATOR, and BULLDOZER OPERATOR.

QUALIFICATIONS PROFILE

1. Formal Education:
   Minimum requirement is usually eighth grade. Graduation from a high school or vocational school supplemented by completion of formal operator training is highly desirable.

2. General Requirements:
   a. Knowledge of work hazards and applicable safety precautions.
   b. Ability to operate and maintain a variety of construction and earth moving equipment.
   c. Ability to detect needed mechanical work and make necessary minor repairs and adjustments.
   d. Ability to understand and follow oral and written instructions.
   e. Ability to establish and maintain effective working relationships with employees.
   f. Possession of a valid operator's license.

3. General Educational Development:
   a. Reasoning:
      (1) Apply common sense understanding to carry out instructions furnished in oral, written or diagrammatic form.
      (2) Deal with problems involving several concrete variables in or from standardized situations.

Title: CONSTRUCTION EQUIPMENT OPERATOR (Cont'd)

b. Mathematical:
Make arithmetic calculations involving fractions, decimals, and percentages.

c. Language:
Communicate with fellow employees during operation of equipment.

4. Specific Vocational Preparation:
Three to six months are required before the worker achieves average proficiency in operating equipment.

5. Aptitudes-Relative to General Working Population:

a.	Intelligence:	Middle third
b.	Verbal:	Lowest third excluding bottom 10%
c.	Numerical:	"
d.	Spatial:	Middle third
e.	Form Perception:	Lowest third excluding bottom 10%
f.	Clerical Perception:	"
g.	Motor Coordination:	Middle third
h.	Finger Dexterity:	"
i.	Manual Dexterity:	"
j.	Eye-Hand-Foot Coordination:	"
k.	Color Discrimination:	Lowest third excluding bottom 10%

6. Interests:
Interest in activities of a concrete and organized nature dealing with things, objects, machines, and techniques.

7. Temperament:
Must adjust to situations involving repetitive operations carried out according to set procedures or sequences.

8. Physical Demands:
The work is light and involves reaching, handling, fingering, hearing, and seeing.

9. Working Condition:
Work is outside and it involves exposure to weather, noise, vibration, hazards, and dust.

ENTRY SOURCES: Maintenance Man I, or General Public.

PROGRESSION TO: Foreman.

OCCUPATIONAL DESCRIPTION

Title: AUTOMOTIVE EQUIPMENT OPERATOR, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Drives automotive equipment such as dump truck and tractor to perform any combination of following tasks: Hauls debris, dirt, gravel, rock, sand, and equipment. Loads and unloads materials and equipment. Drives tractor and controls mowing attachment to cut grass, bushes, and shrubs in maintenance of outfall right-of -way. Cuts and trims trees and bushes, using chainsaw, axe, and other hand tools. Cleans, adjusts, greases, oils, and performs minor repairs to automotive equipment and attachments. Locates job sites, using maps, and records work performed. May act as a crew leader. May give directions to MAINTENANCE MEN I and LABORERS. Performs other manual tasks as directed.

QUALIFICATIONS PROFILE

1. Formal Education:
   Minimum requirement is the completion of eighth grade.

2. General Requirements:
   a. Ability to recognize and report abnormal operating functions of equipment and make necessary mechanical adjustments.
   b. Ability to understand and follow oral and written instructions.
   c. Ability to perform heavy manual labor.
   d. Ability to maintain working relationships with fellow employees.
   e. Possession of a valid driver's license.

3. General Educational Development:
   a. Reasoning:
      (1) Apply common sense understanding to carry out detailed but uninvolved written or oral instructions.
      (2) Deal with problems involving a few concrete variables in or from standardized situations.
   b. Mathematical:
      Use arithmetic to add, subtract, multiply, and divide whole numbers.
   c. Language:
      Ability to understand and carry out instructions and to establish and maintain communication with fellow employees and supervisors.

4. Specific Vocational Preparation:

   Short demonstration only.

Title: AUTOMOTIVE EQUIPMENT OPERATOR (Cont'd)

5. Aptitudes-Relative to General Working Population:
    - a. Intelligence: Lowest third excluding bottom 10%
    - b. Verbal: "
    - c. Numerical: "
    - d. Spatial: Middle third
    - e. Form Perception: Lowest third excluding bottom 10%
    - f. Clerical Perception: "
    - g. Motor Coordination: Middle third
    - h. Finger Dexterity: Lowest third excluding bottom 10%
    - i. Manual Dexterity: Middle third
    - j. Eye-Hand-Foot Coordination: "
    - k. Color Discrimination: Lowest third excluding bottom 10%

6. Interests:

    Preference for activities of a routine, concrete, organized nature that are carried on in relation to machines and techniques.

7. Temperament:

    Must adjust to situations involving repetitive operations carried on according to set procedures or sequences involving doing things only under specific instructions.

8. Physical Demands:

    The work is heavy and involves lifting, reaching, handling, and seeing.

9. Working Conditions:

    Work is both inside and outside.

ENTRY SOURCES: Laborer or General Public.

PROGRESSION TO: Construction Equipment Operator.

OCCUPATIONAL DESCRIPTION

Title: PHOTO-INSPECTION TECHNICIAN, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Operates 35mm camera to conduct internal inspection of sewer lines to determine condition or need for repairs. Locates line sections to be photographed using map. Determines set up procedures. Floats rope attached to tow sack down to adjacent manhole to thread sewer line. Directs MAINTENANCE MEN I in setting up cable stands over manholes. Loads camera with film and inspects battery. Depresses button on camera to photograph small blackboard giving location of manhole, manhole number, date, and type of weather for future reference. Attaches pulling cable to camera and instructs MAINTENANCE MEN I to position camera in sewer line and to turn cable stand handles so camera can move inside pipe. Snaps pictures at designated intervals until camera reaches downstream manhole. Detaches camera from cable, rewinds cable into reel, and disassembles equipment. Removes film and batteries from camera and sends film for development. Confers with MAINTENANCE SUPERVISOR to discuss condition of sewer lines shown in developed photographs. Drives pickup truck to haul crew and equipment. Services, adjusts, and makes minor repairs to camera, equipment, and attachments. Communicates with MAINTENANCE SUPERVISOR, using radio telephone. Gives directions to MAINTENANCE MEN I and LABORERS, instructs them in the efficient and safe use of camera and equipment, trains them in work methods, and ensures that proper procedures and safety precautions are followed. Prepares daily report showing lines photographed.

QUALIFICATIONS PROFILE

1. Formal Education:
   Minimum requirement is completion of eighth grade. Graduation from high school or vocational school is highly desirable.

2. General Requirements:
   a. Knowledge of sewer inspection, maintenance, and repair.
   b. Knowledge of the operation and servicing of photo equipment.
   c. Knowledge of work hazards and applicable safety precautions.
   d. Ability to lead the work of a small crew.
   e. Ability to establish and maintain effective working relationships with employees.
   f. Ability to prepare records showing conditions of sewer lines.
   g. Possession of a valid driver's license.

Title: PHOTO-INSPECTION TECHNICIAN (Cont'd)

3. General Educational Development:
   a. Reasoning:
      (1) Apply common sense understanding to carry out instructions furnished in oral, written or diagrammatic form.
      (2) Deal with problems involving several concrete variables in or from standardized situations.
   b. Mathematical:
      Make arithmetic calculations involving fractions, decimals, and percentages.
   c. Language:
      (1) Confer with superiors to discuss condition of sewer line and give directions to subordinates.
      (2) Prepare operational reports and records.

4. Specific Vocational Preparation:
   Two to three years of experience in the inspection, maintenance, and repair of sewerage system.

5. Aptitudes-Relative to General Working Population:

a. Intelligence:	Middle third
b. Verbal:	"
c. Numerical:	Lowest third excluding bottom 10%
d. Spatial:	Middle third
e. Form Perception:	"
f. Clerical Perception:	Lowest third excluding bottom 10%
g. Motor Coordination:	"
h. Finger Dexterity:	Middle third
i. Manual Dexterity:	"
j. Eye-Hand-Foot Coordination:	Lowest third excluding bottom 10%
k. Color Discrimination:	"

6. Interests:
   A preference for activities dealing with things and objects which are carried on in relation to processes, machines, and techniques.

7. Temperament:
   Must be able to make decisions based on factual information and must have disposition to meet precise, and established standards.

8. Physical Demands:
   Work is medium and involves climbing, stooping, kneeling, crouching, handling, fingering, talking, hearing, and seeing.

Title: PHOTO-INSPECTION TECHNICIAN (Cont'd)

9. Working Conditions:
The work is performed outside and involves contact with water, and exposure to weather, noxious smells, gases, and risk of bodily injury.

ENTRY SOURCES: Maintenance Man I.

PROGRESSION TO: Foreman or Maintenance Supervisor.

OCCUPATIONAL DESCRIPTION

Title: LABORER, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Performs any combination of the following routine tasks involved with construction, repair, and preventive maintenance of storm and sanitary sewers and related structures: Places barricades or traffic cones around work site to protect workmen and public. Conveys materials and tools about job site. Cleans work sites, removes debris, and places tools in truck after completion of job. Breaks pavement and digs ditches, using air hammer, pick, and shovel. Digs dirt from around pipe, shovels, and rakes crushed stone or dirt to desired grade. Backfills ditches, using shovels, and pack dirt, using whacker and tamper. Helps to maneuver and hold pipe sections in position for MAINTENANCE MEN to tighten and caulk connections, using pipe puller. Assists in unclogging storm and sanitary sewers manually or using power operated cleaning tools. Mixes cement, sand, and water to prepare mortar, using shovel. Cuts trees, branches, bushes, and shrubs to clear right-of-way, using chainsaw and axe. Cuts weeds, and grass, using power-mower. Cleans manholes, catch basins, creeks, and ditches. Raises loose bricks and debris from bottom of manhole to surface, and dumps them in truck, using bucket and shovel. Loads and unloads heavy mechanical equipment, dirt, stone, and construction materials on and from truck. Cleans tools and equipment. May drive pickup truck.

QUALIFICATIONS PROFILE

1. Formal Education:
   Required to have completed the eighth grade. Must be able to read and write.

2. General Requirements:
   a. Ability to perform heavy manual labor in all kinds of weather.
   b. Ability to understand and follow oral and written instructions.
   c. Ability to use hand tools and standard equipment.
   d. Ability to maintain working relationships with fellow employees and the public.

3. General Educational Development:
   a. Reasoning:
      Apply common sense understanding to carry out simple 1-or 2- step instructions.

Title: LABORER (Cont'd)

b. Mathematical:
Perform simple addition and subtraction, reading and copying of figures, or counting and recording.

c. Language:
Learn job duties from oral instructions or demonstrations, and request orally, or in writing, work supplies and materials.

4. Specific Vocational Preparation:
No previous experience is necessary.

5. Aptitudes-Relative to General Working Population:
   - a. Intelligence: Lowest third excluding bottom 10%
   - b. Verbal: "
   - c. Numerical: Lowest 10%
   - d. Spatial: Lowest third excluding bottom 10%
   - e. Form Perception: "
   - f. Clerical Perception: Lowest 10%
   - g. Motor Coordination: Middle third
   - h. Finger Dexterity: Lowest third excluding bottom 10%
   - i. Manual Dexterity: Middle third
   - j. Eye-Hand-Foot Coordination: Lowest third excluding bottom 10%
   - k. Color Discrimination: Lowest 10%

6. Interests:
Interest in activities dealing with things and objects and of a routine, concrete, organized nature.

7. Temperament:
Must adjust to situations involving things only under specific instruction, allowing little or no room for independent action or judgment in working out job problems.

8. Physical Demands:
Heavy to very heavy work involving lifting, carrying, climbing, stooping, kneeling, crouching, crawling, reaching, handling, fingering, talking, hearing, and seeing.

9. Working Conditions:
Outside work involving wet conditions and exposure to weather, noise, noxious smells, gases, and risk of bodily injury.

ENTRY SOURCES: Unskilled labor market.

PROGRESSION TO: Maintenance Man I or Mason I.

OCCUPATIONAL DESCRIPTION

Title: MAINTENANCE MECHANIC II, WASTEWATER LIFT STATION

OCCUPATIONAL DEFINITION

Repairs and overhauls wastewater pumping station equipment, using hand tools: Overhauls and repairs centrifugal-type pumps, motors, chlorinators, control valves, comminutors, and related equipment. Lubricates and adjusts pumping station equipment. Replaces packing and filter element, and changes chlorine cylinder. Evaluates station logs and makes recommendations for changes in maintenance procedures. Periodically inspects pumping stations for early detection of malfunctions. Reads and interprets technical manuals and blueprints to facilitate repair and maintenance of equipment. Provides technical assistance and prescribes work methods and safety procedures to MAINTENANCE MECHANIC I and MAINTENANCE MECHANIC HELPER. Drives pickup truck to pumping stations. Requisitions tools and equipment.

QUALIFICATIONS PROFILE

1. Formal Education:
   Graduation from a high school or vocational school is the minimum requirement.

2. General Requirements:
   a. Knowledge of the principles of operation and maintenance of pumps, motors, and related electrical and mechanical pumping station equipment.
   b. Knowledge of work hazards and applicable safety precautions.
   c. Ability to diagnose and repair malfunctions in equipment.

3. General Educational Development:
   a. Reasoning:
      (1) Apply common sense understanding to carry out instructions furnished in oral, written or diagrammatic form.
      (2) Deal with problems involving a few concrete variables in or from standardized situations.
   b. Mathematical:
      Make arithmetic calculations involving fractions, decimals, and percentages.
   c. Language:
      (1) Read and interpret technical manuals and blueprints.
      (2) Read and evaluate station operation logs.

Title: MAINTENANCE MECHANIC II (Cont'd)

4. Specific Vocational Preparation:
Three years experience in the operation, maintenance, and repair of pumps and related mechanical and electrical equipment.

5. Aptitudes-Relative to General Working Population:

a.	Intelligence:	Middle third
b.	Verbal:	Lowest third excluding bottom 10%
c.	Numerical:	Middle third
d.	Spatial:	Highest third excluding top 10%
e.	Form Perception:	Middle third
f.	Clerical Perception:	Lowest third excluding bottom 10%
g.	Motor Coordination:	Middle third
h.	Finger Dexterity:	Highest third excluding top 10%
i.	Manual Dexterity:	"
j.	Eye-Hand-Foot Coordination:	Lowest third excluding bottom 10%
k.	Color Discrimination:	"

6. Interests:
An interest in activities dealing with things and objects which are carried on in relation to processes, machines, and techniques.

7. Temperament:
Must adjust to situations requiring the making of decisions on a judgmental basis and adhere to precise and established standards.

8. Physical Demands:
Medium work involving lifting, climbing, stooping, kneeling, crouching, reaching, handling, fingering, feeling, talking, hearing, and seeing.

9. Working Conditions:
The work is inside and involves contact with water, risk of bodily injury, and exposure to noise, noxious smells, gases, and poor ventilation.

ENTRY SOURCES: Maintenance Mechanic I.

PROGRESSION TO: Maintenance Supervisor.

OCCUPATIONAL DESCRIPTION

Title: MAINTENANCE MECHANIC I, WASTEWATER LIFT STATION

OCCUPATIONAL DEFINITION

Conducts periodic inspection and performs routine preventive maintenance and minor repairs to wastewater pumping stations to ensure efficient operation, using hand tools: Inspects centrifugal-type pumps, comminutors, chlorinators, float switches, valves, fresh-air blowers, and warning alarms to detect malfunctions. Observes and reports malfunctions to MAINTENANCE MECHANIC II and assists in overhaul and major repair of equipment. Lubricates pumps, motors, and drives. Adjusts pump seal to tighten packing, using wrench. Cleans mechanic seal or packing gland. Replaces packing and filter element, and changes chlorine cylinder. Observes, listens to, and feels heat of pump motor to detect unusual noise or vibration. Inspects and cleans bar screen using rake. Washes sides of wet well to control grease accumulation, using water hose. Keeps records and makes routine reports. Drives pickup truck to pumping stations. Gives directions to MAINTENANCE MECHANIC HELPER, instructs him in the efficient and safe use of tools, trains him in work methods, and ensures that proper procedures and safety precautions are followed.

QUALIFICATIONS PROFILE

1. Formal Education:
   Graduation from a high school or vocational school is the minimum requirement.

2. General Requirements:
   a. Knowledge of pumping station equipment.
   b. Knowledge of occupational hazards and necessary safety precautions.
   c. Ability to maintain pumps and related mechanical and electrical equipment.
   d. Ability to detect equipment malfunctions and perform minor repairs.
   e. Possession of a valid driver's license.

3. General Educational Development:
   a. Reasoning:
      (1) Apply common sense understanding to carry out instructions furnished in oral, written, or diagrammatic form.
      (2) Deal with problems involving several concrete variables in or from standardized situations.
   b. Mathematical:
      Make arithmetic calculations involving fractions, decimals, and percentages.

Title: MAINTENANCE MECHANIC I (Con't)

c. Language:
  (1) Keep records and make routine reports.
  (2) Give directions and instructions to helper.

4. Specific Vocational Preparation:
  One to two years experience in varied mechanical work.

5. Aptitudes-Relative to General Working Population:

a.	Intelligence:	Middle third
b.	Verbal:	Lowest third excluding bottom 10%
c.	Numerical:	Middle third
d.	Spatial:	"
e.	Form Perception:	Lowest third excluding bottom 10%
f.	Clerical Perception:	"
g.	Motor Coordination:	Middle third
h.	Finger Dexterity:	"
i.	Manual Dexterity:	"
j.	Eye-Hand-Foot Coordination:	Lowest third excluding bottom 10%
k.	Color Discrimination:	"

6. Interests:
  A preference for activities of a concrete and organized nature dealing with things, objects, processes, machines and techniques.

7. Temperament:
  Must adjust to working with precise and established standards and making decisions on a judgmental basis.

8. Physical Demands:
  Work is medium and it involves lifting, climbing, stooping, kneeling, crouching, reaching, handling, fingering, feeling, talking, hearing, and seeing.

9. Working Conditions:
  Work is outside and involves contact with water , risk of bodily injury, and exposure to noise, noxious smells, and poor ventilation.

ENTRY SOURCES: Maintenance Mechanic Helper.

PROGRESSION TO: Maintenance Mechanic II.

OCCUPATIONAL DESCRIPTION

Title: MAINTENANCE MECHANIC HELPER, WASTEWATER LIFT STATION

OCCUPATIONAL DEFINITION

Assists MAINTENANCE MECHANIC I to inspect and maintain wastewater pumping stations, performing any combination of following tasks: Assists in inspecting, adjusting, and minor repairing of pumping station equipment such as pumps, comminutors, chlorinators, float switches, valves, fresh-air blowers, and warning alarms. Assists in packing and lubricating pumps. Checks and cleans bar screens, using rake. Washes sides of wet well to control grease accumulation, using water hose. Performs routine maintenance to station and grounds, including mowing grass and cutting weeds. Cleans and conveys tools about work site. Performs other related duties as directed by MAINTENANCE MECHANIC I.

QUALIFICATIONS PROFILE

1. Formal Education:
   Minimum requirement is the graduation from a high school or vocational school.

2. General Requirements:
   a. Knowledge of mechanics as related to repairing and maintaining pumps, motors, and related mechanical and electrical equipment.
   b. Knowledge of occupational hazards and necessary safety precautions.
   c. Ability to understand and follow oral and written instructions.

3. General Educational Development:
   a. Reasoning:
      Apply common sense understanding to carry out detailed but uninvolved written or oral instructions.
   b. Mathematical:
      Use arithmetic to add, subtract, multiply, and divide whole numbers.
   c. Language:
      Ability to understand and carry out instructions and to establish and maintain communication with fellow employees and supervisors.

4. Specific Vocational Preparation:
   No previous experience is necessary.

Title: MAINTENANCE MECHANIC HELPER (Cont'd)

5. Aptitudes-Relative to General Working Population:

a.	Intelligence:	Lowest third excluding bottom 10%
b.	Verbal:	"
c.	Numerical:	"
d.	Spatial:	"
e.	Form Perception:	"
f.	Clerical Perception:	"
g.	Motor Coordination:	Middle third
h.	Finger Dexterity:	"
i.	Manual Dexterity:	"
j.	Eye-Hand-Foot Coordination:	Lowest third excluding bottom 10%
k.	Color Discrimination:	"

6. Interests:
Interest in activities of a routine and organized nature dealing with things and objects.

7. Temperament:
Must adjust to situations involving doing things only under specific instructions and must have disposition to adhere exactly to established standards and procedures.

8. Physical Demands:
The work is medium and involves climbing, balancing, stooping, kneeling, crouching, reaching, handling, fingering, feeling, and seeing.

9. Working Conditions:
Work is inside and it involves contact with water, risk of bodily injury, and exposure to noise, noxious odors, gases, and poor ventilation.

ENTRY SOURCES: High School or Vocational School graduates, and General Public.

PROGRESSION TO: Maintenance Mechanic I.

OCCUPATIONAL DESCRIPTION

Title: CONSTRUCTION INSPECTOR SUPERVISOR, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Supervises, coordinates and schedules activities of CONSTRUCTION INSPECTORS engaged in inspecting construction of storm and sanitary sewers and related appurtenances: Assigns construction projects to CONSTRUCTION INSPECTORS. Confers with city engineers and contractors to discuss installation of sewers and city specifications. Studies blueprints and specifications covering construction projects. Conducts periodic field inspection of work in progress and final inspection upon completion of construction project. Inspects major construction activities regarded complex enough to demand his personal attention. Trains and provides technical assistance to subordinates. Examines grades, pipe foundations, pipe jointings, pipe placement, alignment and connections; manholes and invert installation; and backfilling operations and tamping of dirt for compliance with plans and specifications. Keeps records, prepares reports, and makes recommendations concerning work methods and safety procedures.

QUALIFICATIONS PROFILE

1. Formal Education:
   Graduation from a high school, supplemented by courses in engineering, surveying and drafting.

2. General Requirements:
   a. Knowledge of the principles, practices, techniques, equipment, and materials involved in the construction of sanitary and storm sewer lines and related structures.
   b. Ability to read and interpret blueprints and specifications.
   c. Ability to establish and maintain effective working relationships with consulting engineers, contractors, employees, and general public.
   d. Ability to plan, supervise, and coordinate inspection activities.

3. General Educational Development:
   a. Reasoning:
      (1) Apply principles of logical thinking to define problems, collect data, establish facts, and draw valid conclusions.
      (2) Interpret an extensive variety of technical instructions in books, manuals, and mathematical or diagrammatic form.

b. Mathematical:
Perform ordinary arithmetic, algebraic and geometric procedures in standard and practical applications.

c. Language:
- (1) Prepare records and reports.
- (2) Evaluate engineering and technical data and interpret specifications.
- (3) Confer with engineers and contractors.

4. Specific Vocational Preparation:
Four to five years experience in the construction and inspection of sewers.

5. Aptitudes-Relative to General Working Population:

a. Intelligence:	Highest third excluding top 10%
b. Verbal:	"
c. Numerical:	"
d. Spatial:	Middle third
e. Form Perception:	"
f. Clerical Perception:	"
g. Motor Coordination:	Lowest third excluding bottom 10%
h. Finger Dexterity:	"
i. Manual Dexterity:	"
j. Eye-Hand-Foot Coordination:	"
k. Color Discrimination:	"

6. Interests:
Preference for activities of a technical nature and resulting in prestige or the esteem of others.

7. Temperament:
Must adjust to situations involving the direction, control, and planning of activities requiring the evaluation of information against measurable or verifiable criteria. Must also have satisfactory working relationships with people beyond giving and receiving instructions.

8. Physical Demands:
Work is light, involving climbing, stooping, kneeling, crouching, crawling, reaching, handling, feeling, talking, hearing, and seeing.

Title: CONSTRUCTION INSPECTOR SUPERVISOR (Cont'd)

9. Working Conditions:
   Work is performed inside and outside and involves exposure to noise from construction equipment.

ENTRY SOURCES:	Construction Inspector.
PROGRESSION TO:	Director of Public Works, Water and Sewer Administrator, or a similar position in a larger city.

OCCUPATIONAL DESCRIPTION

Title: CONSTRUCTION INSPECTOR, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Inspects all phases of construction of storm and sanitary sewers and related structures to ensure conformity with plans and specifications: Studies blueprints and specifications, preparatory to inspection of construction project. Inspects construction work in progress and upon its completion. Verifies elevation and alignment to which pipe is installed, examines pipe foundations, jointings, placement, alignment, and connections; manholes and invert installations; and backfilling operations and tamping of dirt for compliance with plans and specifications. Measures footage of pipe installed, unit quantity of earth removed, gravel used, and concrete poured. Inspects construction materials to ensure specified quality. Interprets specifications to contractor. Maintains a field book of vital data of each day's work including a descriptive record of equipment and personnel used, a sketch of trench conditions and field location of utilities exposed by construction work, and a report on field and weather conditions. Coordinates construction work of project with the operations of gas, water, telephone, and electric companies and other city departments. Selects samples of materials for testing. Ascertains and promptly refers to CONSTRUCTION INSPECTOR SUPERVISOR field conditions or problems requiring changes in the work or correction of improper construction procedures. Observes installing contractor in performance of infiltration, exfiltration, and low pressure air tests to ensure soundness and tightness of sewer installations. Visually inspects sewer lines to ensure proper installation, using lamp or mirror. Recommends acceptance or requirement of additional work upon completion of project. Prepares progress and final reports to city for payment. Confers with city engineer, contractors, and CONSTRUCTION INSPECTOR SUPERVISOR.

QUALIFICATIONS PROFILE

1. Formal Education:
   Graduation from a high school or vocational school is the minimum requirement, preferably supplemented by courses in civil engineering, drafting and surveying.

2. General Requirements:
   a. Knowledge of methods, practices, equipment, and materials used in the construction of sanitary and storm sewer lines and related appurtenances.

Title: CONSTRUCTION INSPECTOR (Cont'd)

b. Ability to read and interpret blueprints, plans, and specifications.
c. Ability to establish and maintain effective working relationships with consulting engineers and contractors.
d. Ability to keep records and make reports.

3. General Educational Development:
   a. Reasoning:
      (1) Apply construction principles to solve practical problems and deal with a variety of concrete variables in situations where only limited standardization exists.
      (2) Interpret a variety of instructions furnished in written, oral, diagrammatic, or schedule form.
   b. Mathematical:
      Perform ordinary arithmetic, algebraic, geometric procedures in standard and practical applications.
   c. Language:
      (1) Confer with engineers, contractors, and superiors.
      (2) Interpret specifications and blueprints.

4. Specific Vocational Preparation:
   Two to three years experience in construction or survey work. Experience as construction foreman is particulary desirable.

5. Aptitudes-Relative to General Working Population:

a. Intelligence:	Highest third excluding top 10%
b. Verbal:	"
c. Numerical:	"
d. Spatial:	Middle third
e. Form Perception:	Highest third excluding top 10%
f. Clerical Perception:	Middle third
g. Motor Coordination:	Lowest third excluding bottom 10%
h. Finger Dexterity:	"
i. Manual Dexterity:	"
j. Eye-Hand-Foot Coordination:	"
k. Color Discrimination:	"

6. Interests:
   Interest in activities technical in nature and are carried on in relation to processes, machines, and techniques.

7. Temperament:
   Must adjust to situations involving the evaluation of information against measurable or verifiable criteria and must adhere to precise and established standards indicated by detailed written specifications and blueprints.

Title: CONSTRUCTION INSPECTOR (Cont'd)

8. Physical Demands:
   Work is light, involving climbing, stooping, kneeling, crouching, crawling, reaching, handling, feeling, talking, hearing, and seeing.

ENTRY SOURCES:	Construction Foreman, Maintenance Man II or Draftsman.
PROGRESSION TO:	Construction Inspector Supervisor.

OCCUPATIONAL DESCRIPTION

Title: DISPATCHER, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Dispatches work crews to repair and unstop storm and sanitary sewer lines according to complaints received from public: Answers telephone to receive complaints and requests for service from general public. Records caller's name, address, and type of complaint. Locates site of trouble spot using map. Checks truck log to determine location of nearest available work crew. Transmits information and work orders to MAINTENANCE SUPERVISOR or to proper field crew, using radio telephone. Compiles, types, logs, and files information on complaints received and completed assignments, such as manpower and equipment utilization, lines cleaned, and number of stoppages opened. Maintains truck log indicating location of work crews. Types and maintains reports on street cuts and contacts street department for repavement. Files sewer maps by streets showing location and measurements of storm and sanitary sewer lines and appurtenances for future reference. Performs related routine typing and filing duties.

QUALIFICATIONS PROFILE

1. Formal Education:
   High school graduate.

2. General Requirements:
   a. Knowledge of the activities, methods, and operating policies and procedures of the department.
   b. Ability to speak clearly.

3. General Educational Development:
   a. Reasoning:
      (1) Apply common sense understanding to carry out instructions furnished in oral or written form.
      (2) Deal with problems involving several concrete variables in or from standardized situations.
   b. Mathematical:
      Make arithmetic calculations involving fractions, decimals, and percentages.
   c. Language:
      (1) Communicates with employees and public.
      (2) Prepares maintenance reports.

4. Specific Vocational Preparation:
   Commercial courses in high school or business school.

Title: DISPATCHER (Cont'd)

5. Aptitudes-Relative to General Working Population:

a.	Intelligence:	Middle third
b.	Verbal:	"
c.	Numerical:	"
d.	Spatial:	Lowest third excluding bottom 10%
e.	Form Perception:	"
f.	Clerical Perception:	Middle third
g.	Motor Coordination:	Lowest third excluding bottom 10%
h.	Finger Dexterity:	"
i.	Manual Dexterity:	"
j.	Eye-Hand-Foot Coordination:	Lowest 10%
k.	Color Discrimination:	"

6. Interests:
   A preference for activities involving business contact with people and the communication of ideas.

7. Temperament:
   Must have satisfactory working relationships with people and must adjust to situations requiring the making of decisions on a judgmental basis.

8. Physical Demands:
   Sedentary work involving reaching, handling, fingering, talking, hearing, and seeing.

9. Working Conditions:
   Work is performed inside.

ENTRY SOURCES: High School graduates or General Public.

PROGRESSION TO: Progress in grade only.

OCCUPATIONAL DESCRIPTION

Title: STOCK CLERK, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Requisitions, receives, examines, stores, records, and issues supplies, equipment, tools and parts used in municipal wastewater collection system: Fills purchase orders for materials, using manufacturers' catalogs and parts lists as reference. Receives, counts, and examines incoming supplies to verify compliance with purchase requests. Sorts and places items in bins. Maintains inventory control system. Conducts periodic and perpetual inventory to verify accuracy of stock control records. Posts materials used and unit cost on inventory cards and in proper accounts. Prepares periodic records showing utilization of supplies. Issues supplies, tools, and equipment to workers, and assists them in filling out standard forms. Determines storage and identification methods and initiates changes in operation policies and procedures. Cleans and dusts shelves and storeroom.

QUALIFICATIONS PROFILE

1. Formal Education:
   High school graduate.

2. General Requirements:
   a. Knowledge of standard storeroom methods and procedures.
   b. Knowledge of types of materials, supplies, tools, and equipment stored by the department.
   c. Ability to maintain perpetual inventory system and stock records.

3. General Educational Development:
   a. Reasoning:
      (1) Apply common sense understanding to carry out instructions furnished in oral, written, or diagrammatic form.
      (2) Deal with problems involving several concrete variables in or from standardized situations.
   b. Mathematical:
      Make arithmetic calculations involving fractions, decimals, and percentages.
   c. Language:
      Fill out purchase orders, post figures on inventory cards, and prepare inventory records.

Title: STOCK CLERK (Cont'd)

4. Specific Vocational Preparation:
   Six months to one year of storekeeping experience.

5. Aptitudes-Relative to General Working Population:
   - a. Intelligence: Middle third
   - b. Verbal: Lowest third excluding bottom 10%
   - c. Numerical: Middle third
   - d. Spatial: "
   - e. Form Perception: "
   - f. Clerical Perception: "
   - g. Motor Coordination: Lowest third excluding bottom 10%
   - h. Finger Dexterity: "
   - i. Manual Dexterity: "
   - j. Eye-Hand-Foot Coordination: "
   - k. Color Discrimination: "

6. Interests:
   Preference for activities of a routine, concrete and organized nature dealing with things and objects.

7. Temperament:
   Must adjust to working with precise and established standards of accuracy in situations involving the evaluation of information against measurable or verifiable criteria.

8. Physical Demands:
   The work is medium and involves frequent lifting, stooping, reaching, and handling.

9. Working Conditions:
   Work is performed inside.

ENTRY SOURCES: Storekeepers or High School graduates.

PROGRESSION TO: Progress in grade only.

OCCUPATIONAL DESCRIPTION *

Title: CLERK TYPIST, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Performs any combination of following tasks and/or other clerical duties: Operates typewriter and other standard office machines and equipment; including adding machine, calculator, and duplicating machine. Serves as secretary to superintendent. Acts as receptionist. Responsible for personal work determination in accordance with established precedent or policy. Sets up simple office routines and filing systems. Minor supervisory responsibilities. Composes routine correspondence. Answers telephone and handles routine inquiries from public. Typing includes tables, reports, requisitions, forms, and other material from copy, draft, or dictating machines; frequently involving judgment regarding format or information to be included. Clerical duties include maintaining financial records not requiring technical bookkeeping skills. Duties ordinarily include posting, filing, sorting, and other routine clerical functions.

QUALIFICATIONS PROFILE

1. Formal Education:
   High school graduate or equivalent, including or supplemented by courses in typing and other commercial subjects.

2. General Requirements:
   a. Considerable knowledge of modern office methods and procedure.
   b. Knowledge of business English, spelling, and arithmetic.
   c. Ability to operate standard office equipment and type minimum of 40 words per minute.
   d. Ability to maintain records and prepare reports.
   e. Ability to deal effectively with public by telephone and in person.
   f. Ability to exercise independent judgment.

3. General Educational Development:
   a. Reasoning:
      Apply common sense understanding to carry out general instructions.
   b. Mathematical:
      Make arithmetic calculations involving percentages and decimals.

---

* Black & Veatch, Estimating Costs and Manpower Requirements for Conventional Wastewater Treatment Facilities, pp. 151-152.

Title: CLERK TYPIST (Cont'd)

c. Language:

Ability to transcribe dictation, make appointments and handle routine correspondence.

4. Specific Vocational Preparation:
   - a. Commercial courses in high school or business school.
   - b. Minimum one year progressively responsible general office experience, including typing and operation of office equipment.

5. Aptitudes-Relative to General Working Population:

a. Intelligence:	Middle third
b. Verbal:	"
c. Numerical:	"
d. Spatial:	"
e. Form Perception:	"
f. Clerical Perception:	Highest third excluding top 10%
g. Motor Coordination:	"
h. Finger Dexterity:	"
i. Manual Dexterity:	"
j. Eye-Hand-Foot Coordination:	Middle third
k. Color Discrimination:	"

6. Interests:

Prefer activities of a concrete, organized nature involving business contact with people.

7. Temperament:

Worker must adjust to situations involving a variety of duties characterized by frequent change.

8. Physical Demands:

Sedentary work.

9. Working Conditions:

Inside work.

ENTRY SOURCES: Employment Agencies or General Public.

PROGRESSION TO: Progress in Grade only.

5. DESCRIPTIONS OF TASKS

A training curriculum is dependent on the availability of an accurate and adequate picture of the tasks and requirements of the job. Task Descriptions offer information on the nature of jobs and provide a framework for developing successful training programs.

Task Descriptions presented in this Manpower Manual are based on extensive field observations of maintenance crews and numerous interviews with supervisory personnel and engineering technicians. This chapter presents Descriptions of Tasks for three unit processes of the wastewater collection system:

Page

I. Sanitary Sewer Maintenance

1. Operation of High Velocity Water Jet 84
2. Operation of Power Rodder 85
3. Operation of Bucket Machine 86
4. Operation of Wayne Ball Machine 88
5. Operation of 35mm Camera 89
6. Opening of Stopped Main Line 90
7. Opening of Stopped Lateral Line 91
8. Repair of Main Line 92
9. Operation of Sewer Tapping Machine 92
10. Inspection and Cleaning of Manhole 94
11. Bypassing of Manhole 94
12. Manhole Repair 95
13. Raising Manhole Walls 95
14. Installation of Prefabricated Manhole 96

II. Storm Sewer Maintenance

1. Operation of High Velocity Water Jet 98
2. Opening of Stopped Storm Line 98
3. Repair of Storm Line 98
4. Inspection and Cleaning of Manhole 98
5. Manhole Repair 98
6. Raising Manhole Walls 98
7. Installation of Prefabricated Manhole 98
8. Catch Basin Inspection and Cleaning 99
9. Catch Basin Repair 100

III. Lift Station Maintenance

1. Lift Station Inspection and Maintenance 101

UNIT PROCESS: SANITARY SEWER MAINTENANCE

OCCUPATION	DESCRIPTION OF TASKS
	1. OPERATION OF HIGH VELOCITY WATER JET.
M. Eq. Op.:	Receives work assignments for the day from MAINTENANCE SUPERVISOR.
M. Eq. Op.:	Drives water jet truck to work site.
M. Eq. Op.:	Locates manholes, using map.
M. Eq. Op.:	Drives water jet truck to nearest hydrant.
M. Man I :	Connects sewer jet fill hose to hydrant and turns water on to fill water tank, using hydrant wrench.
M. Eq. Op.:	Observes gauge to determine when water tank is full and signals MAINTENANCE MAN I to turn water off.
M. Man I :	Turns water off and disconnects hose, using hydrant wrench.
M. Eq. Op.:	Determines position of water jet truck.
M. Man I :	Erects barricades or traffic cones to protect workers and divert traffic around work area.
M. Man I :	Lifts covers of adjacent manholes, using pick.
M. Man I :	Checks condition of manholes and presence of blockage.
M. Eq. Op.:	Observes manholes to determine location of blockage.
M. Man I :	Inserts roller guide into manhole.
M. Man I :	Inserts funnel in downstream invert of manhole.
M. Eq. Op.:	Inserts nozzle of hose down manhole through roller guide into mainline.
M. Eq. Op.:	Starts machine to eject water rearward from nozzle to create a thrust that forces hose through pipe.
M. Eq. Op.:	Observes water pressure and foot indicator gauges to ascertain length of hose in line and to determine when obstruction is met.
M. Eq. Op.:	Manipulates levers to direct movement of hose which flushes pipe with pressured water and forces debris downstream.
M. Man I.:	Follows and observes flow of water down mainline and signals to MAINTENANCE EQUIPMENT OPERATOR when obstruction is removed.
M. Eq. Op.:	Moves levers to draw hose back.
M. Man I :	Removes roller guide from manhole.
M. Eq. Op.:	Washes down manhole, using pressure gun.
M. Man I :	Removes accumulated debris and deposits them in truck, using long handle shovel.
M. Eq. Op.:	May use gas detector to assure safety of MAINTENANCE MAN I prior to his descending into manhole.
M. Eq. Op.:	May operate air blower to ventilate manhole.

OCCUPATION	DESCRIPTION OF TASKS
M. Eq. Op.:	Ensures MAINTENANCE MAN I dons safety harness before entering manhole.
M. Man I :	Puts on safety harness if he has to climb down into manhole.
M. Man I :	May descend into manhole to remove debris, using rope, bucket, and invert shovel.
M. Man I :	Removes funnel from manhole.
M. Man I :	May climb down into manhole and place mirror near invert while MAINTENANCE EQUIPMENT OPERATOR holds other mirror on street facing sun, to cast reflected sunlight into the sewer, to determine condition of line.
M. Man I :	Replaces manhole covers, using pick.
M. Man I :	Cleans work site, removes debris and places tools in truck after completion of operation.
M. Eq. Op.:	Fills out work report showing sewer lines flushed.
M. Eq. Op.:	Fills out work order if sewer lines or manholes need repair.

****

2. OPERATION OF POWER RODDER

M. Eq. Op.:	Receives work assignments for the day from MAINTENANCE SUPERVISOR.
M. Eq. Op.:	Drives power rodder truck to work site.
M. Eq. Op.:	Locates lines to be rodded, using map.
M. Eq. Op.:	Determines position of power rodder truck.
M. Man I :	Erects barricades or traffic cones to protect workers and divert traffic around work area.
M. Man I :	Lifts manhole covers, using pick.
M. Eq. Op.:	Examines water level in manhole to determine clogging and need for rodding line.
M. Man I :	Cleans manhole and invert using long handle shovel and fork.
M. Man I :	Removes rod guide and pipe jack from side of power rodder.
M. Eq. Op.:	Starts motor and moves lever to engage power rodder and to turn rod a foot out of rod guide.
M. Man I :	Attaches 4 inch auger to rod, using wrench.
M. Man I :	Lowers rod guide and pipe jack into manhole, using rope attachment.
M. Man I :	Walks over to downstream manhole, observes invert and signals to MAINTENANCE EQUIPMENT OPERATOR when rod reaches that manhole.
M. Eq. Op.:	Moves lever to advance rod in sewer line.
M. Eq. Op.:	Observes gauges to ascertain length of rod in pipe.

OCCUPATION	DESCRIPTION OF TASKS
M. Eq. Op. :	Moves levers to slow down rod when obstruction is met and to increase thrust force that rotates auger to bore through and loosen deposits.
M. Eq. Op. :	Pushes lever to stop drive and release rotation power of rod when MAINTENANCE MAN I signals that auger has reached downstream manhole.
M. Man I :	May pull up front end of rod to surface at downstream manhole, using pick rod; replace auger with a root cutter, using wrench; and lower rod back into manhole.
M. Man I :	Signals to MAINTENANCE EQUIPMENT OPERATOR to retract rod.
M. Eq. Op. :	Moves lever to reverse tool rotation, to retract and pull back rod to loosen obstruction.
M. Eq. Op. :	May repeat process with larger size augers.
M. Man I :	Observes flow of water in downstream manhole and signals to MAINTENANCE EQUIPMENT OPERATOR when flow runs freely.
M. Eq. Op. :	Observes flow of waste water to ensure success of operation.
M. Man I :	Pulls out rod guide and pipe jack from manhole, using rope.
M. Man I :	Removes deposits from manhole, auger, and rod and places them in buckets on truck to be hauled away for disposition.
M. Man I :	Detaches auger from rod, using wrench.
M. Man I :	Replaces manhole covers, using pick.
M. Man I :	Cleans work site, removes debris and places tools back in truck after completion of operation.
M. Eq. Op. :	Completes work report showing sewer lines rodded.
M. Eq. Op. :	Fills out work order if sewer lines or manholes need repair.

****

3. OPERATION OF BUCKET MACHINE

M. Eq. Op. :	Receives work assignments for the day from MAINTENANCE SUPERVISOR.
M. Eq. Op. :	Drives truck to work site.
M. Eq. Op. :	Locates sewer lines to be cleaned, using map.
M. Eq. Op. :	Determines set up procedures and directs MAINTENANCE MAN I (A) and MAINTENANCE MAN I (B) in threading sewer line with rope and winch cable.
M. Man I :	(A) removes upstream manhole cover.
M. Man I :	(B) locates fire hydrant and connects fire hose, using hydrant wrench.

OCCUPATION	DESCRIPTION OF TASKS
M. Eq. Op.:	Lays out hose to upstream manhole.
M. Man I :	(A) connects control valve on end of fire hose.
M. Eq. Op.:	Signals (B) to turn fire hydrant on.
M. Man I :	(B) turns fire hydrant on slowly.
M. Eq. Op.:	Signals (A) to close control valve when hose is filled.
M. Man I :	(A) closes control valve at upstream manhole.
M. Man I :	(B) walks over to downstream manhole and removes cover, using pick.
M. Eq. Op.:	Attaches tow sack to rope.
M. Eq. Op.:	Inserts tow sack into invert to thread line.
M. Man I :	(A) turns control valve so water pressure can push tow sack with rope to downstream manhole to thread line.
M. Man I :	(B) removes tow sack, pulls out , and secures rope at downstream manhole.
M. Man I :	(A) turns control valve off and secures rope at upstream manhole.
M. Man I :	(B) turns off fire hydrant and disconnects hose.
M. Man I :	(A) opens control valve to drain fire hose.
M. Man I :	(A) and (B) retrieve hose and valve.
M. Eq. Op.:	Ensures that sewer line is threaded properly.
M. Eq. Op.:	Sets up power winches and roller guides over the two manholes with the assistance of (A) and (B).
M. Eq. Op.:	Stations (A) at upstream manhole and (B) at downstream manhole.
M. Man I :	(B) attaches winch cable to rope.
M. Man I :	(A) pulls rope through sewer line to upstream manhole to thread line with winch cable.
M. Eq. Op.:	Attaches both cables to ends of bucket so bucket can be pulled inside sewer line with winch cable.
M. Eq. Op.:	Inserts bucket in sewer line and directs (A) and (B) in operating the bucket machine.
M. Man I :	(B) activates lower winch to pull bucket in line which opens bucket jaws to scoop up debris.
M. Man I :	(B) disengages lower power winch when bucket is believed to be full.
M. Man I :	(A) activates upper power winch to draw bucket back which closes bucket jaws.
M. Man I :	(A) pulls bucket up to surface, empties contents in truck, and inserts bucket back in line.
M. Man I :	(A) and (B) repeat process until line is cleaned.
M. Man I :	(A) detaches winch cables from ends of bucket.
M. Man I :	(B) withdraws cable downstream and rewinds cable onto reel.
M. Man I :	(A) and (B) clean manholes, using long handle shovel, remove debris from work site, and dump them in truck to be hauled away for disposition.
M. Man I :	(A) and (B) replace manhole covers, using pick.
M. Eq. Op.:	Observes flow of waste water to ensure success of operation.
M. Eq. Op.:	Completes work report showing sewer lines rodded.
M. Eq. Op.:	Fills out work order if sewer lines or manholes need repair.

OCCUPATION	DESCRIPTION OF TASKS
	4. OPERATION OF WAYNE BALL MACHINE
M. Eq. Op.:	Receives work assignments for the day from MAINTENANCE SUPERVISOR.
M. Eq. Op.:	Drives truck to work site.
M. Eq. Op.:	Locates sewer lines to be cleaned, using map.
M. Man I :	MAINTENANCE MAN I (A) removes upstream manhole cover, using pick.
M. Eq. Op.:	Inspects sections of sewer lines to be cleaned to determine conditions of lines and work hazards involved.
M. Eq. Op.:	Determines set up and operation procedures.
M. Man I :	MAINTENANCE MAN I (B) locates fire hydrant and connects fire hose, using hydrant wrench.
M. Man I :	(A) lays out hose to upstream manhole and connects control valve on end of fire hose.
M. Man I :	(B) turns fire hydrant on slowly.
M. Man I :	(A) closes control valve at upstream manhole when hose is filled.
M. Man I :	(B) walks over to downstream manhole, removes cover, using pick, and places sand trap in manhole to catch ball and debris.
M. Eq. Op.:	Sets up hand winch over upper manhole.
M. Eq. Op.:	May use power winch if line is larger than 12 inches.
M. Eq. Op.:	Attaches wayne ball to end of cable.
M. Eq. Op.:	Inserts ball into sewer line.
M. Man I :	(A) turns control valve on and off as directed by MAINTENANCE EQUIPMENT OPERATOR to control water pressure in sewer line causing the ball to move downstream and remove accumulated debris in its way.
M. Eq. Op.:	Takes precautions to ensure ball does not become loose in line or ball does not build up excessive pressure that may cause plumbing fixture to overflow.
M. Man I :	(B) detaches wayne ball from cable when ball reaches downstream manhole.
M. Man I :	(B) removes debris from manhole, using long handle shovel.
M. Man I :	(A) retracts cable, manually or using winch.
M. Man I :	(A) and (B) replace manhole covers, using pick.
M. Man I :	(A) and (B) place tools and equipment back in truck, remove debris from work site and dumps them in truck to be hauled away for disposition.
M. Eq. Op.:	Completes work report showing sewer lines cleaned.
M. Eq. Op.:	Fills out work order if sewer lines or manholes need repair.

****

5. OPERATION OF 35mm CAMERA

OCCUPATION	DESCRIPTION OF TASKS
Ph. I. T.:	Receives work assignments for the day from MAINTENANCE SUPERVISOR.
Ph. I. T.:	Drives truck to work site.
Ph. I. T.:	Locates sewer lines to be photographed, using map.
Ph. I. T.:	Determines set up procedures and directs MAINTENANCE MAN I (A) and MAINTENANCE MAN I (B) in threading sewer line with rope and winch cable.
M. Man I:	(A) removes upstream manhole cover.
M. Man I:	(B) locates fire hydrant and connects fire hose, using hydrant wrench.
Ph. I. T.:	Lays out hose to upstream manhole.
M. Man I:	(A) connects control valve on end of fire hose.
Ph. I. T.:	Signals (B) to turn fire hydrant on.
M. Man I:	(B) turns fire hydrant on slowly.
Ph. I. T.:	Signals (A) to close control valve when hose is filled.
M. Man I:	(A) closes control valve at upstream manhole.
M. Man I:	(B) walks over to downstream manhole and removes cover, using pick.
Ph. I. T.:	Attaches tow sack to rope.
Ph. I. T.:	Inserts tow sack into invert to thread line.
M. Man I:	(A) turns control valve so water pressure can push tow sack with rope to downstream manhole to thread line.
M. Man I:	(B) removes tow sack, pulls out, and secures rope at downstream manhole.
M. Man I:	(A) turns control valve off and secures rope at upstream manhole.
M. Man I:	(B) turns off fire hydrant and disconnects hose.
M. Man I:	(A) opens control valve to drain fire hose.
M. Man I:	(A) and (B) retrieve hose and valve.
Ph. I. T.:	Ensures that sewer line is threaded properly.
M. Man I:	(A) and (B) set up cable winches at both manholes.
Ph. I. T.:	Loads camera with film and inspects battery.
Ph. I. T.:	Attaches control cable to camera.
Ph. I. T.:	Depresses button on camera to photograph small blackboard which gives location of manhole, manhole number, date and type of weather for future reference.
M. Man I:	Attaches pulling cables to camera.
M. Man I:	(A) climbs down manhole and positions camera in invert of sewer line.
M. Man I:	(B) tightens pulling cable.
M. Man I:	(A) and (B) turn handles of cable winches manually to move camera inside line.
Ph. I. T.:	Observes footage gauge and records distances travelled by camera on a schedule sheet.
M. Man I:	(A) and (B) stop winding cable every four feet, following directions from PHOTO-INSPECTION TECHNICIAN to allow the taking of pictures.

OCCUPATION	DESCRIPTION OF TASKS
Ph. I. T.:	Snaps pictures at designated intervals until camera reaches downstream manhole or until camera encounters an obstruction and cannot pass through line.
M. Man I :	(B) descends into manhole and detaches camera from cable when camera reaches downstream.
M. Man I :	(A), in case of an obstruction in line, rewinds cable onto reel to retract camera to upstream manhole and detaches camera.
Ph. I. T.:	Removes film and batteries from camera.
M. Man I :	(A) and (B) rewind cables onto reels, disassemble, clean, and return equipment to truck.
M. Man I :	(A) and (B) replace manhole covers, using pick.
Ph. I. T.:	Fills out work report showing sewer lines photographed.

****

6. OPENING OF STOPPED MAIN LINE

M. Man II :	Drives service pick up truck to work site.
M. Man II :	Locates manholes, using map.
M. Man I :	Removes manhole covers, using pick.
M. Man I :	Inspects manholes and relays condition of wastewater flow to MAINTENANCE MAN II.
M. Man II :	Inspects manholes to determine location of stoppage.
M. Man II, I:	Runs rods through rod guide, fits front end of rod with auger, using wrench, and lowers guide into position.
M. Man II ,I:	Thrusts rods into invert and advances them until auger reaches obstruction.
M. Man II, I:	May rotate rod manually, using turning pin.
M. Man II :	May attach end of rod to portable power rodder to rotate rods until auger loosens and dislodges debris inside pipe.
M. Man I :	Retracts rods and drags out obstructions such as roots, grease, and other deposits.
M. Man II :	Checks adjacent manholes for flow to ascertain efficiency of operation.
M. Man I :	Replaces manhole covers, using pick.
M. Man I :	Cleans work site, removes debris and places tools in truck after completion of operation.
M. Man II :	Completes work report showing sewer lines unstopped.

OCCUPATION	DESCRIPTION OF TASKS
	7. OPENING OF STOPPED LATERAL LINE *
M. Man II	Receives assignment from DISPATCHER or MAINTENANCE SUPERVISOR.
M. Man II	Determines location from map or address.
M. Man II	Drives service pick up truck to work site.
M. Man II	Checks with house residents to discuss complaint and confirm problem.
M. Man II	Locates cleanout visually or using dip needle or M-Scope if cleanout is not visible.
M. Man I	Assists Maintenance Man II in locating cleanout.
M. Man I	Uncovers cleanout, if underground, by digging from around it, using shovel.
M. Man I	May have to dig down to lateral line, using shovel, if cleanout does not exist or cannot be located.
M. Man I	Removes cleanout plug using wrench and hammer and lifts covers off adjacent manholes, using pick.
M. Man II	Observes flow of sewage in cleanout to determine whether stoppage occurs on city or private property.
M. Man II,I	Removes portable electric cleaning machine from truck and carries it to work site.
M. Man II	Attaches bit to end of cable, using wrench.
M. Man II	Inserts cable into line through cleanout to remove roots and debris in line.
M. Man II	Connects machine to generator.
M. Man II	Pulls hand lever and depresses foot control of machine to advance cleaning tool slowly until it encounters an obstruction and to rotate cable until obstacle is broken.
M. Man I	Retracts cable from line when water flows freely showing success of operation.
M. Man II	May deposit dye tablets in cleanout to determine whether water is flowing to manhole downstream.
M. Man II	Checks line for structural damage and reports to MAINTENANCE SUPERVISOR if repairs are needed.
M. Man I	Cleans work site
M. Man II, I	Disassembles machine and puts it back on truck.
M. Man I	Replaces manhole cover and cleanout plug, using pick and wrench.
M. Man II	Calls DISPATCHER to report work done.
M. Man II	Fills out work order if lines need repair.

---

* If it is the responsibility of the municipality.

OCCUPATION DESCRIPTION OF TASKS

8. REPAIR OF MAIN LINE

Foreman : Receives work order from MAINTENANCE SUPERVISOR.
Foreman : Locates job site, using map.
Foreman : Drives pick up truck to work site.
Foreman : Reads blueprints to determine location of existing utilities lines and city right-of-way limits.
Foreman : Determines work procedures and directs workers.
M. Man I : Removes tools and equipment from truck and erects barricades or traffic cones to protect workers and divert traffic around work area.
Foreman : Measures distance of excavation site, using tape measure and marks outline of area to be trenched.
M. Man II, I: Breaks asphalt and other pavement, using air hammer, pick and shovel.
Foreman : Directs CONSTRUCTION EQUIPMENT OPERATOR in the digging of trench.
C. Eq. Op. : Moves hand and foot levers to operate back hoe to excavate trench.
M. Man I : Digs dirt away from pipe, using shovel.
Foreman : Examines sewer line to determine need for repair and to decide on corrective action to take.
M. Man II : Cuts damaged section of pipe with cutters and removes broken section from ditch.
M. Man II : Replaces broken pipes and reconnects pipe sections, using pipe sleeve.
M. Man I : Assists MAINTENANCE MAN II in replacing pipe.
Foreman : Inspects joints to ensure they are tight and sealed properly before backfilling.
C. Eq. Op. : Operates back hoe to backfill trench.
M. Man II, I: Packs backfilled excavation, using tamper.
M. Man I : Cleans work sites, removes debris, and places tools, equipment, and barricades back on truck.
Foreman : Fills out work report showing line repaired and manpower, equipment, and material utilization.

****

9. OPERATION OF SEWER TAPPING MACHINE

M. Man II : Receives assignment from MAINTENANCE SUPERVISOR.

OCCUPATION	DESCRIPTION OF TASKS
M. Man II :	Locates work site, using map.
M. Man II :	Drives pick up truck to work site.
M. Man I :	Removes tools and materials from truck.
M. Man I :	Lowers needed tools and material into trench.
M. Man II :	Climbs down into trench.
M. Man II :	Wraps chain around sewer mainline.
M. Man II :	Positions tapping machine on side of sewer mainline.
M. Man II :	Hooks chain to tapping machine.
M. Man II :	Tightens chain to mainline, using wrench.
M. Man II :	Positions motor on tapping machine.
M. Man I :	Fills cooling water reservoir with water.
M. Man I :	Attaches water hose to reservoir.
M. Man I :	Positions reservoir on bank of ditch.
M. Man II :	Attaches other end of hose to tapping machine.
M. Man II :	Checks blade of tapping machine.
M. Man II :	Pulls crank cord to start motor on sewer tapping machine.
M. Man II :	Moves valve to turn on water.
M. Man II :	Turns feed control knob to engage cutter with pipe until hole is cut into sewer main.
M. Man II :	Moves switch to turn off machine.
M. Man II :	Turns feed control knob to disengage cutter from pipe.
M. Man II :	Turns valve to cut off cooling water.
M. Man I :	Disassembles sewer tapping machine and accessories and removes them from trench.
M. Man II :	Wipes and dries hole clean with rag.
M. Man II :	Spreads epoxy adhesive compound on pipe and fitting.
M. Man II :	Places and presses fitting into hole.
M. Man II&I:	Place strap around main, hook, and tighten saddle to pipe.
M. Man I :	Cleans machine and accessories and returns them to truck.

****

10. INSPECTION AND CLEANING OF A MANHOLE

M. Man II :	Receives assignment from MAINTENANCE SUPERVISOR.
M. Man II :	Drives truck to work site.
M. Man II :	Locates manhole, using map.
M. Man I :	Erects traffic cones to protect workers and divert traffic around work area.
M. Man I :	Takes manhole cover off, using pick. May have to use sledge hammer to loosen cover if it is stuck.
M. Man I :	Removes debris from bottom of manhole using long handled shovel,

OCCUPATION	DESCRIPTION OF TASKS
	long hook, spoon, fork or rod, raises them to surface and places them in bucket.
M. Man II :	Examines condition of manhole and invert, notes location on map and fills work order for needed repairs to be submitted to MAINTENANCE SUPERVISOR.
M. Man II :	May use gas detector to assure safety of MAINTENANCE MAN I prior to his descending into manhole.
M. Man II :	May operate air blower to ventilate manhole.
M. Man II :	Ensures MAINTENANCE MAN I dons safety harness before entering manhole.
M. Man I :	Puts on safety harness if he has to climb down into manhole.
M. Man I :	May descend into manhole after getting clearance from MAINTENANCE MAN II, to remove debris, using rope and invert shovel.
M. Man I :	Replaces manhole cover, using pick.
M. Man I :	Removes debris from work site and discharges contents of bucket into truck to be hauled away for disposition.

****

11. BYPASSING OF MANHOLE*

M. Man I :	Erects traffic cones.
M. Man I :	Lifts manhole covers, using pick.
M. Man II :	Determines size and capacity of pump to be used.
M. Man I :	Removes pump and tools from truck.
M. Man II :	Positions pump at upper manhole.
M. Man I :	Lays discharge hose or pipe from pump to lower manhole.
M. Man I :	Secures hose in lower manhole.
M. Man II :	Lowers suction hose in invert of upper manhole.
M. Man II :	Positions inflammable plug in lower invert of upper manhole.
M. Man II :	Inflates plug using air pump.
M. Man II :	Starts pump so wastewater would bypass manhole.
M. Man II :	Turns pump off, deflates plug, and dismantles discharge and suction hose.
M. Man I :	Places pump and attachments back in truck.

---

* The "bypass" method is used to enable the worker to work in a dry manhole without blocking the flow of wastewater.

OCCUPATION DESCRIPTION OF TASKS

12. MANHOLE REPAIR

Mason II : Receives work order from MAINTENANCE SUPERVISOR.
Mason II : Drives truck to work site.
Mason II : Locates manhole, using map.
Mason I : Removes tools and materials from truck and erects traffic cones.
Mason I : Takes manhole cover off, using pick.
Mason II : Inspects manhole to ascertain condition of structure and need for repair.
Mason I : May inspect manhole and relay condition of structure to MASON II.
Mason II&I: Dewater manhole if necessary, using one of the following two methods: Bypass manhole (see item 11) or place flow-through-sewer plug with semi-rigid hose into inlet of manhole in order to maintain a dry work site in manhole.
Mason II&I: Climb down manhole steps.
Mason II : Chips away concrete along cracks, using hammer and chisel to prepare for repairs.
Mason I : Raises loose bricks and debris from bottom of manhole to surface and loads them in truck, using bucket and shovel.
Mason I : Mixes cement, sand, and water to prepare mortar, using shovel and wheelbarrow.
Mason I : Deposits mortar on board so MASON II can reach it.
Mason II : Replaces fallen bricks and patches cracks and eroded inverts with fresh mortar, using trowel.
Mason II : Smooths and finishes surfaces of concrete walls to specified textures, using float.
Mason I : Removes dewatering device to start flow after cement has dried.
Mason I : Replaces manhole cover, using pick.
Mason I : Cleans work site, and places tools and materials back on truck.
Mason II : Fills out work report showing manhole repaired.

****

13. RAISING MANHOLE WALLS

Mason II : Receives assignment from MAINTENANCE SUPERVISOR.
Mason II : Drives truck to work site.
Mason II : Locates manhole, using map.
Mason I : Removes tools and materials from truck and erects traffic cones.

OCCUPATION DESCRIPTION OF TASKS

Mason I : Removes manhole ring and cover, using sledge hammer and pick.
Mason II : Dewaters manhole (see item 12).
Mason II : Climbs down manhole steps.
Mason II : Places protective cover over invert.
Mason II : Knocks rim off manhole and breaks top of manhole walls, using sledge hammer.
Mason I : Mixes cement, sand, and water to prepare mortar, using shovel and wheelbarrow.
Mason I : Conveys materials and tools about job site.
Mason I : Deposits mortar on board so MASON II can reach it.
Mason II : Spreads mixed cement on existing layer of brick, using trowel.
Mason II : Presses bricks into cement mixture and lays them to specified level.
Mason II : Places rim over brick and cements rim to insure that cover is secure in place.
Mason I : Removes protective cover.
Mason I : Replaces manhole cover, using pick.
Mason I : Cleans work site and deposits debris and tools on truck.
Mason II : Completes work report identifying manhole walls raised.

****

14. INSTALLATION OF A PREFABRICATED MANHOLE

Mason II : Receives work order from MAINTENANCE SUPERVISOR.
Mason II : Drives truck to work site.
Mason II : Locates manhole, using map.
Mason I : Removes tools and materials from truck and erects traffic cones.
Mason II : Directs CONSTRUCTION EQUIPMENT OPERATOR to excavate around manhole.
C. Eq. Op. : Moves hand and foot levers to operate back hoe to excavate around manhole.
Mason II : Dewaters manhole (see item 12).
Mason I : Climbs down into manhole and places protective cover over invert.
Mason II : Directs MASON I or CONSTRUCTION EQUIPMENT OPERATOR to break walls of standing manhole.
Mason I : Breaks walls of standing manhole, using sledge hammer.
C. Eq. Op. : May operate back hoe to break walls of old manhole.
Mason II : Prepares surface or pours new invert.
Mason I : Descends into manhole, removes debris and raises them into surface using rope and bucket.

OCCUPATION	DESCRIPTION OF TASKS
Mason II	Signals to CONSTRUCTION EQUIPMENT OPERATOR to align pre-cast manhole and to press it into proper position.
C. Eq. Op.	Operates back hoe to align pre-cast manhole and to press it into proper position.
Mason I	Mixes cement, sand, and water to prepare mortar, using shovel and wheelbarrow.
Mason I	Deposits mortar on board so MASON II can reach it.
Mason II	Applies mortar mix on area between pre-cast concrete and existing walls to secure it in position.
Mason I	Removes protective cover.
Mason I	Replaces manhole cover and ring, using pick.
Mason I	Backfills and tamps ground around manhole.
C. Eq. Op.	May operate back hoe to backfill and tamp ground around manhole.
Mason I	Cleans work site and deposits debris and tools on truck.
Mason II	Completes work report identifying newly installed prefabricated manhole.

UNIT PROCESS: STORM SEWER MAINTENANCE

OCCUPATION

DESCRIPTION OF TASKS

1. OPERATION OF HIGH VELOCITY WATER JET.
   (see page 84).

****

2. OPENING OF STOPPED STORM LINE.
   (same as Opening of Stopped Main Line, see page 90).

****

3. REPAIR OF STORM LINE.
   (same as Repair of Main Line, see page 92).

****

4. INSPECTION AND CLEANING OF MANHOLE.
   (see page 93).

****

5. MANHOLE REPAIR
   (see page 95).

****

6. RAISING MANHOLE WALLS.
   (see page 95).

****

7. INSTALLATION OF A PREFABRICATED MANHOLE.
   (see page 96).

****

OCCUPATION	DESCRIPTION OF TASKS

8. CATCH BASIN INSPECTION AND CLEANING

M. Man II :	Receives assignment from MAINTENANCE SUPERVISOR
M. Man II :	Drives truck to work site.
M. Man II :	Locates catch basin, using map.
M. Man I :	Removes tools from truck and erects traffic cones.
M. Man I :	Removes catch basin cover, using pick.
M. Man I :	May have to use sledge hammer to loosen cover.
M. Man II :	Inspects catch basin to determine presence of debris.
M. Man I :	Descends into basin to remove debris from bottom of catch basin, using shovel, spoon, or fork, raises deposits to surface, and places them in bucket.
M. Man II :	Lowers bucket to MAINTENANCE MAN I in basin to dump accumulated debris into bucket.
M. Man II :	Flushes basin, using fire hose with creeping nozzle attachment.
M. Man II :	Examines basin to ensure removal of all debris.
M. Man I :	Replaces catch basin cover, using pick.
M. Man I :	Cuts grass from around catch basin, using bushax.
M. Man I :	Removes debris from worksite, using shovel and discharges contents of bucket into truck to be hauled away for disposition.
M. Man I :	Returns bushax and handtools to truck.
M. Man II :	Completes work report showing catch basin cleaned and inspected.
M. Man II :	Prepares work order if catch basin needs repair.

****

9. CATCH BASIN REPAIR

Mason II :	Receives assignment from MAINTENANCE SUPERVISOR.
Mason II :	Drives truck to work site.
Mason II :	Locates catch basin, using map.
Mason I :	Removes tools and materials from truck and erects traffic cones.
Mason I :	Connects chain to truck and catch basin cover.
Mason II :	Drives truck to pull catch basin cover.
Mason II :	Examines catch basin to determine needed repairs.
Mason II :	Climbs down into basin.
Mason II :	Chips away concrete along cracks, using hammer and chisel.
Mason I :	Raises loose bricks and debris from bottom of manhole to surface and loads them on truck, using bucket and shovel.
Mason I :	Mixes cement, sand, and water to prepare mortar using shovel and wheelbarrow.
Mason I :	Deposits mortar on board so MASON II can reach it.

OCCUPATION	DESCRIPTION OF TASKS
Mason II :	Patches cracks and broken parts of catch basin, using mortar and trowel.
Mason II :	Drives truck to pull back cover on catch basin.
Mason II :	Inspects cover to ensure proper fit.
Mason I :	Cleans work site, and places tools and materials back on truck.
Mason II :	Fills out work report showing catch basin repaired.

UNIT PROCESS: LIFT STATION MAINTENANCE

OCCUPATION DESCRIPTION OF TASKS

INSPECTION AND PERFORMANCE OF PREVENTIVE MAINTENANCE ON A LIFT STATION

M. Mech. H. : Opens station gate, using key.
M. Mech. H. : Pulls open wet well hatch.
M. Mech. H. : Unlocks and pulls open door of pit.
M. Mech. I : Observes bar screen to determine need for cleaning.
M. Mech. H. : Removes debris from screen using rake, and deposits them in container for disposal.
M. Mech. H. : Washes down sides of wet well, using water hose.
M. Mech. H. : Closes and locks door of pit.
M. Mech. I : Turns humidifier control knob on to make necessary adjustments.
M. Mech. I : Inspects operation of fresh air blower.
M. Mech. I : Climbs into lift station dry pump pit or chamber.
M. Mech. I : Observes pump in operation to detect faulty seal.
M. Mech. I : Feels pump motor in operation to determine relative temperature and vibration and to detect malfunctions.
M. Mech. I : Lifts sump pump float momentarily to check operation of sump pump.
M. Mech. I : May wash mechanic seal filter.
M. Mech. I : Turns pump control panel switch to off position.
M. Mech. I : Turns off control valves on water seal line.
M. Mech. I : Unscrews filter ball and filter element.
M. Mech. I : Soaks filter element to clean it.
M. Mech. I : May replace filter element.
M. Mech. I : Turns pump control panel switch to on position.
M. Mech. I : Tests pumps, using manual switch setting, to ensure they are primed and will pump flow when automatically started.
M. Mech. I : Observes packing ring to detect water leak.
M. Mech. I : Tightens ring down if it is leaking, using wrench.
M. Mech. I : May replace ring, using packing iron press, pipe wrench, and other hand tools.
M. Mech. I : Turns valve off to stop flow of sewage.
M. Mech. I : Inspects shaft surface for excessive wear.
M. Mech. I : Removes packing ring clamp, using wrench.
M. Mech. I : Cuts packing to fit around shaft, using pocket knife.
M. Mech. I : Pushes packing around shaft, using packing iron press.
M. Mech. I : Places packing ring clamp back on and tightens it down, using wrench.
M. Mech. I : Observes position of check valve lever arm with pumps on and off, and notes normal position of lever for each mode.

OCCUPATION	DESCRIPTION OF TASKS
M. Mech. I :	Turns control valve on air pressure tank to bleed off water and air, and checks air compressor's control points.
M. Mech. I :	Inspects switches to see if any are in tripped position; if so, clears trouble, resets switch and re-energizes.
M. Mech. I :	Raises and lowers weights on float switches to make sure they move freely and that float cables are tracking properly.
M. Mech. I :	Observes well levels at start and stop positions.
M. Mech. I :	Inspects to ensure that pressure relief valve lets excess pressure bleed back into wet well when pressure approaches rated force main limit.
M. Mech. I :	Reads pressure surges on pressure gauge.
M. Mech. I :	Presses test button to inspect automatic high water warning alarms.
M. Mech. I :	Inspects chlorinator.
M. Mech. I :	Ensures that chlorinator is on the correct feed grade and verifies that it works automatically when pump units are pumping.
M. Mech. I :	Checks chlorinator for gas leaks.
M. Mech. I :	Turns valve on tank and disconnects feed line to change chlorine cylinders.
M. Mech. I :	Turns control knob to adjust feed rate.
M. Mech. I :	Fills out routine report form on sewer lift station operation.
M. Mech. I :	Records readings of running time meters if provided.
M. Mech. I :	Inspects comminutor.
M. Mech. I :	May turn switch to stop comminutor if metal objects are noted in cutter blades.
M. Mech. I :	Locks comminutor switch in off position when greasing bearing or removing metal object.
M. Mech. H. :	Removes old rags, sticks, and rocks from inside of pumping station.
M. Mech. H. :	Sweeps floor of lift station, using broom.
M. Mech. H. :	Cuts grass around pumping station, using power mower.
M. Mech. I :	Contacts MAINTENANCE MECHANIC II when equipment needs repair, using radio.

APPENDIX I

DEFINITIONS OF WORKER TRAITS*

Those abilities, personal traits, and individual characteristics required of a worker in order to achieve average successful job performance are referred to as worker traits. They are reflected in the following six distinct components that provide the broadest and yet most comprehensive framework for the effective presentation of worker trait information: (1) The amount of general educational development and specific vocational preparation a worker must have, (2) the specific capacities and abilities required of him in order to learn or perform certain tasks or duties, (3) preferences for certain types of work activities or experiences considered necessary for job success, (4) types of occupational situations to which an individual must adjust, (5) physical activities required in work situations, and (6) physical surroundings prevalent in jobs.

GENERAL EDUCATIONAL DEVELOPMENT

This embraces those aspects of education (formal and informal) which contribute to the worker's (a) reasoning development and ability to follow instructions, and (b) acquisition of "tool" knowledges, such as language and mathematical skills. It is education of a general nature which does not have a recognized, fairly specific, occupational objective. Ordinarily such education is obtained in elementary school, high school, or college. It also derives from experience and individual study.

SPECIFIC VOCATIONAL PREPARATION

The amount of time required to learn the techniques, acquire information, and develop the facility needed for average performance in a specific job-worker situation. This training may be acquired in a school, work, military, institutional, or avocational environment. It does not include orientation training required of even every fully qualified worker to become accustomed to the specific conditions of any new job. Specific vocational training includes training given in any of the following circumstances:

1. Vocational education (such as high school commercial or shop training, technical school, art school, and that part of college training which is organized around a specific vocational objective);
2. Apprentice training (for apprenticeable jobs only);
3. In-plant training (given by an employer in the form of organized

---

* Developed by the United States Department of Labor and used as occupational analysis specifications in the Dictionary of Occupational Titles.

classroom study);

4. On-the-job training (serving as learner or trainee on the job under the instruction of a qualified worker);

5. Essential experience in other jobs (serving in less responsible jobs which lead to the higher grade job or serving in other jobs which qualify).

APTITUDES

Specific capacities or abilities required of an individual in order to facilitate the learning of some task or job duty.

INTELLIGENCE: General learning ability. The ability to "catch on" or understand instructions and underlying principles. Ability to reason and make judgments. Closely related to doing well in school.

VERBAL: Ability to understand meanings of words and ideas associated with them, and to use them effectively. To comprehend language, to understand relationships between words, and to understand meanings of whole sentences and paragraphs. To present information or ideas clearly.

NUMERICAL: Ability to perform arithmetic operations quickly and accurately.

SPATIAL: Ability to comprehend forms in space and understand relationships of plane and solid objects. May be used in such tasks as blueprint reading and in solving geometry problems. Frequently described as the ability to "visualize" objects of two or three dimensions, or to think visually of geometric forms.

FORM PERCEPTION: Ability to perceive pertinent detail in objects or in pictorial or graphic material; to make visual comparisions and discriminations and see slight differences in shapes and shadings of figures and widths and lengths of lines.

CLERICAL PERCEPTION: Ability to perceive pertinent detail in verbal or tabular material; to observe differences in copy, to proof read words and numbers, and to avoid perceptual errors in arithmetic computation.

MOTOR COORDINATION: Ability to coordinate eyes and hands or fingers rapidly and accurately in making precise movements with speed. Ability to make a movement response accurately and quickly.

FINGER DEXTERITY: Ability to move the fingers and manipulate small objects with the fingers rapidly or accurately.

MANUAL DEXTERITY: Ability to move the hands easily and skillfully. To work with the hands in placing and turning motions.

EYE-HAND-FOOT COORDINATION: Ability to move the hand and foot coordinately with each other in accordance with visual stimuli.

COLOR DISCRIMINATION: Ability to perceive or recognize similarities or differences in colors, or in shades or other values of the same color; to identify a particualr color, or to recognize harmonious or contrasting color combinations, or to match colors accurately.

INTERESTS

Preferences for certain types of work activities or experience, with accompanying rejection of contrary types of activities or experience. Five pairs of interest factors are provided so that a positive preference for one factor of a pair also implies rejection of the other factor of that pair.

1. Situations involving a preference for activities dealing with things and objects.	vs.	6. Situations involving a preference for activities concerned with people and the communication of ideas.
2. Situations involving a preference for activities involving business contact with people.	vs.	7. Situations involving a preference for activities of a scientific and technical nature.
3. Situations involving a preference for activities of a routine, concrete, organized nature.	vs.	8. Situations involving a preference for activities of an abstract and creative nature.
4. Situations involving a preference for working for people for their presumed good, as in the social welfare sense, or for dealing with people and language in social situations.	vs.	9. Situations involving a preference for activities that are nonsocial in nature, and are carried on in relation to processes, machines, and techniques.
5. Situations involving a preference for activities resulting in prestige or the esteem of others.	vs.	0. Situations involving a preference for activities resulting in tangible, productive satisfaction.

TEMPERAMENTS

Different types of occupational situations to which workers must adjust.

1. Situations involving a variety of duties often characterized by frequent change.

2. Situations involving repetitive or short cycle operations carried out according to set procedures or sequences.

3. Situations involving doing things only under specific instruction, allowing little or no room for independent action or judgment in working out job problems.

4. Situations involving the direction, control, and planning of an entire activity or the activities of others.

5. Situations involving the necessity of dealing with people in actual job duties beyond giving and receiving instructions.

6. Situations involving working alone and apart in physical isolation from others, although the activity may be integrated with that of others.

7. Situations involving influencing people in their opinions, attitudes, or judgments about ideas or things.

8. Situations involving performing adequately under stress when confronted with the critical or unexpected or when taking risks.

9. Situations involving the evaluation (arriving at generalizations, judgments, or decisions) of information against sensory or judgmental criteria.

O. Situations involving the evaluation (arriving at generalizations, judgments, or decisions) of information against measurable or verifiable critiera.

X. Situations involving the interpretation of feelings, ideas, or facts in terms of personal viewpoint.

Y. Situations involving the precise attainment of set limits, tolerances, or standards.

PHYSICAL DEMANDS

Those physical activities required of a worker in a job. The physical demands referred to serve as a means of expressing both the physical requirements of the job and the physical capacities (specific physical traits) a worker must have to meet the requirements.

1. LIFTING, CARRYING, PUSHING, and PULLING. These are the primary "strength" physical requirements, and, generally speaking, a person who engages in one of these activities can and does engage in all. Specifically, each of these activities can be described as:

LIFTING: Raising or lowering an object from one level to another; includes upward pulling.

CARRYING: Transporting an object, usually holding it in the hands or arms, or on the shoulder.

PUSHING: Exerting force upon an object so that the object moves away from the force. This includes slapping, striking, kicking, and treadle actions.

PULLING: Exerting force upon an object so that the object moves toward the force; includes jerking.

The five degrees of this factor (Lifting, Carrying, Pushing, and /or Pulling) are:

SEDENTARY WORK: Lifting 10 lbs. maximum and occasionally lifting and/or carrying such articles as dockets, ledgers, and small tools. Although a sedentary job is defined as one which involves sitting, a certain amount of walking and standing is often necessary in carrying out job duties. Jobs are sedentary if walking and standing are required only occasionally and other sedentary criteria are met.

LIGHT WORK: Lifting 20 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 10 lbs. Even though the weight lifted may be only a negligible amount, a job is in this category when it involves sitting most of the time with a degree of pushing and pulling of arm and/or leg controls.

MEDIUM WORK: Lifting 50 lbs. maximum with frequent lifting and /or carrying of objects weighing up to 25 lbs.

HEAVY WORK: Lifting 100 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 50 lbs.

VERY HEAVY WORK: Lifting objects in excess of 100 lbs. with frequent lifting and/or carrying of objects weighing 50 lbs. or more.

2. CLIMBING and/or BALANCING. These activities are defined as follows:

   CLIMBING: Ascending or descending ladders, stairs, scaffoldings, ramps, poles, ropes, and the like, using feet and legs and/or hands and arms.

   BALANCING: Maintaining body equilibrium to prevent falling when walking, standing, crouching, running, on narrow, slippery, or erratically moving surfaces; or maintaining body equilibrium when performing gymnastic feats.

3. STOOPING, KNEELING, CROUCHING, and/or CRAWLING. These activities are defined as:

   STOOPING: Bending the body downward and forward by bending the spine at the waist.

   KNEELING: Bending the legs at the knees to come to rest on the knee or knees.

   CROUCHING: Bending the body downward and forward by bending the legs and spine.

   CRAWLING: Moving about on the hands and knees or hands and feet. The activities in this factor involve full use of the lower extremities as well as the back muscles. Therefore, stooping rarely is rated when the worker is performing this act while in a sitting position.

4. REACHING, HANDLING, FINGERING and/or FEELING. These activities involve the use of one or both of the upper extremities and are defined as follows:

   REACHING: Extending the hands and arms in any direction.

   HANDLING: Seizing, holding, grasping, turning, or otherwise working with the hands or hand (fingering not involved).

   FINGERING: Picking, pinching, or otherwise working with the fingers primarily (rather than with the whole hand or arm as in handling).

   FEELING: Perceiving attributes of objects such as size, shape, temperature, or texture by means of receptors in the skin, particularly those of the finger tips.

5. TALKING and/or HEARING. These activities are defined as follows:

   TALKING: Expressing or exchanging ideas by means of spoken words.

   HEARING: Perceiving the nature of sounds by the ear.

   The ability to talk is important for those job-worker situations in which the individual must impart oral information to clients or to the public, and in those situations in which he must convey detailed or important spoken instructions to other employees accurately, loudly, or quickly. Hearing is important for those **job-worker situations** which require the ability to receive detailed information through oral communication, and to make fine descriminations in sounds, such as making fine adjustments on running engines.

6. SEEING. Obtaining impressions through the eyes of the shape, size, distance, motion, color, or other characteristics of objects. The major visual functions are defined as follows:

   ACUITY-FAR: Sharpness of vision at a distance of 20 feet or more.

   ACUITY-NEAR: Sharpness of vision at 20 inches or less.

   DEPTH PERCEPTION: Three-dimensional seeing and is an important factor in judging distances and space relationships so as to see objects where and as they actually are. Two-eyed vision is involved here.

   FIELD OF VISION: The area that can be seen up or down or to the right or left while the eyes are fixed on a given point.

   ACCOMODATION: The adjustment of the lens of the eye to bring an object into sharp focus. This item is especially important when doing near-point work at varying distances from the eye.

   COLOR VISION: The ability to identify and distinguish colors.

WORKING CONDITIONS

The physical surroundings of a worker in a specific job. Also known as Environmental Conditions.

1. INSIDE, OUTSIDE, or BOTH. These conditions are defined as follows:

INSIDE: Protection from weather conditions, but not necessarily from temperature changes.

OUTSIDE: No effective protection from weather.

BOTH: Inside and outside.

A job is considered "inside" if the worker spends approximately 75 per cent or more of his time inside, and "outside" if he spends approximately 75 per cent or more of his time outside. A job is considered "both" if the activities occur inside or outside in approximately equal amounts.

2. EXTREME COLD PLUS TEMPERATURE CHANGES. These conditions are defined as follows:

   EXTREME COLD: Temperature sufficiently low to cause marked bodily discomfort unless the worker is provided with exceptional protection.

   TEMPERATURE CHANGES: Variations in temperature which are sufficiently marked and abrupt to cause noticeable bodily reactions.

3. EXTREME HEAT PLUS TEMPERATURE CHANGES. These conditions are defined as follows:

   EXTREME HEAT: Temperature sufficiently high to cause marked bodily discomfort unless the worker is provided with exceptional protection.

   TEMPERATURE CHANGES: Variations in temperature sufficiently marked and abrupt to cause noticeable bodily reactions.

4. WET and HUMID. These conditions are defined as follows:

   WET: Contact with water or other liquids.

   HUMID: Atmospheric condition with moisture content sufficiently high to cause marked bodily discomfort.

5. NOISE and VIBRATION.

   Sufficient noise, either constant or intermittent, to cause marked distraction or possible injury to the sense of hearing and/or sufficient vibration (production of an oscillating movement or strain on the body or its extremities from repeated motion or shock) to cause bodily harm if endured day after day.

6. HAZARDS.

This category includes a variety of industrial hazards, such as proximity to moving mechanical parts, electrical shock, working on scaffolding and high places, exposure to burns and radiant energy, and exposure to all types of explosives, all of which involve the risk of bodily injury.

7. FUMES, ODORS, TOXIC CONDITIONS, DUST, and POOR VENTILATION. These conditions are grouped because they all affect the respiratory system or the skin and are defined as follows:

FUMES: Smoky or vaporous exhalations, usually odorous, thrown off as the result of combustion or chemical reaction.

ODORS: Noxious smells, either toxic or nontoxic.

TOXIC CONDITIONS: Exposure to toxic dust, fumes, gases, vapors, mists, or liquids which cause general or localized disabling conditions as a result of inhalation or action on the skin.

DUST: Air filled with small particles of any kind, such as textile, dust, flour, wood, leather, feathers, and inorganic dust, including silica and asbestos, which make the work place unpleasant or are the source of occupational diseases.

POOR VENTILATION: Insufficient movement of air causing a feeling of suffocation; or exposure to drafts.

APPENDIX 2

GLOSSARY

Compiled from various texts, journals, technical papers and the "Glossary-Water Control Engineering": APHA, ASCE, AWWA, WPCF, 1969.

AUGER: A sharp tool used to go through various materials that become lodged in sewer lines. They are used for opening sewer line stoppages.

APPURTENANCES: Machinery, appliances, or auxiliary structures attached to a main structure to enable it to function, but not considered an integral part of it.

BACKFILL: The operation of refilling an excavation, usually after some structure has been placed therein.

BACKHOE: An excavating machine in which the bucket is rigidly attached to a hinged stick on the boom and is drawn toward the machine in operation.

BEDDING: The earth or other materials on which a pipe or conduit is supported.

BIT: Cutting blade used in rodding operations.

BUCKET MACHINE: A sewer cleaning machine used when large amounts of sand, gravel, and solid material are blocking the sewer lines. Pulling the bucket back causes the jaws to close and retain the solids that are in the bucket.

BULLDOZER: A tractor driven machine having a broad, blunt horizontal blade for clearing land and road building.

CAULKING: The process of driving, pouring, or forcing lead, oakum, plastic, or other material into a joint to make it leakproof.

CATCH BASINS: A catch basin is a form of grit chamber intended to retain the heavy debris in stormwater which otherwise would be carried into the sewer.

CENTRIFUGAL PUMP: A pump consisting of an impeller fixed on a rotating shaft and enclosed in a casing, and having an inlet and a discharge connection. The rotating impeller creates pressure in the liquid by the velocity derived from centrifugal force.

CHLORINATOR: An apparatus to regulate the flow of gas from a cylinder into a sewer line.

CLEANOUT: A pipe that slopes to the street surface from a Y in the sewer and makes it possible to rod the line.

COMBINED SEWER: A sewer intended to receive both wastewater and storm or surface water.

COMMINUTORS: A machine that cuts up solids in raw sewage in preparation for purifying treatment.

COUPLING: A threaded sleeve used to connect two pipes.

CULVERT: A closed conduit for the free passage of surface drainage water under a highway, railroad, canal, or other embankment.

DEBRIS: Any material, including floating trash, suspended sediment, or bed load, moved by a flowing stream.

DEWATER: To drain or remove water from an enclosure. A structure may be dewatered so that it can be inspected or repaired.

DIP-NEEDLE: A magnetic needle pivoted to rotate in the vertical plane of the magnetic meridian with its rotation axis through its center of gravity, so that it points in the direction of the earth's magnetic intensity.

DOMESTIC WASTEWATER: Wastewater derived principally from dwellings, business buildings, institutions, and the like.

EXFILTRATION: The leakage from sewer lines into the surrounding ground.

FITTINGS (PIPE): Connections, appliances, and adjuncts designed to be used in connection with pipes.

FLOAT (CONTROL): A float installed in a tank or body of liquid to control the pumps.

FLOW: The movement of a stream of water or other mobile substance from place to place; a stream of water; movement of silt, water, sand, or other material.

FLUSHING: The removing of deposits of material which have lodged in conduits, sewers, or tanks because of inadequate velocity of flows. Water is discharged into the conduits at such rates that the larger flow and higher velocities are sufficient to remove the material.

GAGE: A device for indicating the magnitude or position of an element in specific units when such magnitude or position undergoes change; examples of such elements are the elevation of a water surface, the velocity of flowing water, the pressure of water, the amount of intensity of precipitation, and the depth of snowfall.

GAS (SEWER): Gas evolved in sewers that results from the decomposition of the organic matter in the wastewater. Also, any gas present in the wastewater system, even though it is from such sources as gas mains, gasoline, cleaning fluid.

GRADE: The elevation of the invert of the bottom of a pipeline, canal, culvert, sewer, or similar conduit.

HIGH VELOCITY WATER JET: A sewer cleaning equipment with a special high velocity hose that is fitted with a hardened steel jet nozzle. It is used to spray-clean sewer lines.

INDUSTRIAL WASTEWATER: Wastewater in which the liquid wastes from industrial processes, as distinct from domestic or sanitary wastes, predominate.

INFILTRATION: The quantity of groundwater that leaks into a pipe through joints, porous walls, or breaks.

INLET: An opening in the street surface usually in the gutter, designed to permit the passage of water from the street surface into the sewer line.

INVERT: The floor, bottom, or lowest portion of the internal cross section of a sewer.

JOINT: A connection between two lengths of pipe, made either with or without the use of a third part.

LATERAL SEWER LINE: A sewer that discharges into a branch or other sewer and has no other common sewer tributary to it.

MAIN SEWER LINE: A sewer line that receives wastewater from many tributary branches and sewer lines, serving as an outlet for a large territory.

MANHOLE: An opening in a sewer provided for the purpose of permitting a man to enter or leave the sewer.

M-SCOPE: An instrument for locating underground metal water pipes by electronic detection. It is also called a pipe finder.

OUTFALL SEWER LINE: A sewer that receives wastewater from a collecting system or from a treatment plant and carries it to a point of final discharge.

OUTLET: Downstream opening or discharge end of a pipe, culvert, or canal.

PIPE JACK: A jack used to fasten roller guides to secure an object within a manhole.

PIT (PUMP): A dry well or chamber below ground level in which a pump is located.

PLUMBING FIXTURES: Receptacles that receive liquid, water, or wastewater and discharge them into a drainage system.

POLLUTION: A condition created by the presence of harmful or objectionable material in water.

POWER RODDER: A sewer cleaning machine fitted with auger rods, that are inserted in a sewer line to dislodge and cut roots and debris.

PUMPING STATION: A pumping station that lifts the wastewater to a higher elevation when the continuance of the sewer at reasonable slopes would involve excessive depths of trench, or that raises wastewater from areas too low to drain into available sewers. These stations may be equipped with pneumatic ejectors or centrifugal pumps.

RIGHT-OF-WAY: A right of passage over another person's land.

ROD GUIDE: A bent pipe inserted in a manhole to guide rods into sewer lines.

ROD (SEWER): A light metal rod, three to four feet long with a coupling at each end. Rods are joined and pushed into a sewer to dislodge obstructions.

RODDING MACHINE: A sewer cleaning machine fitted with auger rods that are inserted in a sewer line to dislodge and cut roots and debris.

ROLLER GUIDE: A suspended pulley that guides a hose or a rope around the edge of a sewer line.

RUN-OFF: The part of rainfall that enters storm sewers.

SADDLE: An assembly of circumferential metal straps on a pipe where a connection is to be installed.

SAND TRAP: A device for separating sand from water.

SANITARY SEWER LINE: A sewer that carries liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with minor quantities of ground , storm, and surface waters that are not admitted intentionally.

SANITARY WASTEWATER: Wastewater discharging from the sanitary conveniences of dwellings (including apartment houses and hotels), office buildings, industrial plants, or institutions.

SERVICE CONNECTION: A pipeline, with its appurtenances, that branches off or connects a water or sewer main with premises.

SCREED: A strike board usually used to level up or strike off concrete pavement slabs or to cushion courses for block pavements.

SEWAGE: The spent water of a community. Term now being replaced in technical usage by preferable term wastewater.

SEWER: A pipe or conduit that carries wastewater or drainage water.

SEWERAGE: System of piping, with appurtenances, for collecting and conveying wastewater from source to discharge. Term declining in use.

SEWER JET: A sewer cleaning equipment with a special high velocity hose that is fitted with a hardened steel jet nozzle. It is used to spray-clean sewer lines.

SIPHON (INVERTED): A pipeline crossing a depression or passing under a structure and having a reversal in grade on a portion of the line, thus creating a V - or U-shaped section of conduit. The line is under positive pressure from inlet to outlet and should not be confused with a siphon. Also called depressed sewer.

SLEEVE: A pipe fitting for uniting two pipes of the same nominal diameter in a straight line.

SOUNDING ROD: A T-shaped tool that is pushed into earth to locate pipes.

STORM SEWER LINE: A sewer that carries storm water and surface water, street wash and other wash waters, or drainage, but excludes domestic wastewater and industrial wastes. Also called storm drain.

SUMP PUMP: A small pump with its impeller submerged in the pumped liquid.

TAMP: A tool for tamping used to drive dirt down by a success of light or medium blows.

TAPPING MACHINE: A machine for cutting and tapping a small hole in a pipe, as a street main, that is either empty or carrying pressure. Two classes of tapping machines are made, designated as pressure-tapping and dry tapping machine. They are sometimes called drilling machine.

TELEGROUT-PACKING: A sewer sealing equipment that is used with conjunction with a television camera. It is pulled through the sewer line and at the infiltration point its packer is inflated and a compound is pumped which seals the pipe.

TELEVISION INSPECTION: The inspection by closed circuit television of the inside of a sewer line achieved by pulling a TV camera through the line.

TOW SACK: A sack made of burlap that is inserted into sewer line and used to thread the line.

TRENCH: An excavation made for installing pipes, masonry walls, and for other purposes. A trench is distinguished from a ditch in that the opening is temporary and is eventually backfilled.

TROWEL: A masonry tool consisting of a flat or less commonly curved blade with a handle and used to apply, spread, shape, and smooth mortar or concrete.

TURNING PIN: A tool used to insert end of rod coupling and to rotate rod

VAC-ALL: An equipment that removes solids from a manhole as they are deposited by a high velocity cleaner and returns the water to the sewer in a sanitary method.

VALVES: The openings through which water enters and leaves the cylinders of a displacement pump.

WASTEWATER: The spent water of a community. From the standpoint of source, it may be a combination of the liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with any groundwater, surface water, and storm water that may be present. In recent years, the word wastewater has taken precedence over the word sewage.

WASTEWATER COLLECTION SYSTEM: System of piping, with appurtenances, for collecting and conveying wastewater from source to discharge. Term increasing in use.

WASTEWATER TREATMENT: Any process to which wastewater is subjected in order to remove or alter its objectionable constituents and thus render it less offensive or dangerous.

WAYNE BALL MACHINE: A sewer cleaning equipment that utilizes a spirally grooved ball which is pumped into the line to build up water pressure loosening, as a result, the accumulated debris to the next manhole for removal.

WET WELL: A compartment in which a liquid is collected, and to which the suction pipe of a pump is connected.

APPENDIX 3

BIBLIOGRAPHY

Black & Veatch. "Estimating Costs and Manpower Requirements for Conventional Wastewater Treatment". Environmental Protection Agency. Washington, D.C.: 1972.

Olympus Research Corporation. Manpower Planning for Wastewater Treatment Plants. Office of Water Programs, Environmental Protection Agency, Washington, D.C.: 1972.

Public Service Department. Sewer Maintenance Manual. City of Sioux City, Iowa: 1971.

Synectics Corporation. Manpower Factors Manual. Environmental Protection Agency. Washington, D.C.

U.S. Department of Labor, Dictionary of Occupational Titles. Washington, D.C.: 1965.

U.S. Department of Labor, Handbook for Analyzing Jobs. Manpower Administration. Washington, D.C.: 1972.

U.S. Department of Labor, "A Handbook for Job Restructuring". Manpower Administration. Washington, D.C.: 1969.

Water Pollution Control Federation. Design and Construction of Sanitary and Storm Sewers. (MOP 9). Washington, D.C.: 1970.

Water Pollution Control Federation. Sewer Maintenance. (MOP 7). Washington, D.C.: 1966.

Whittenburg, John A. "Pilot Study to Determine Manpower Requirements for Conventional Sewage Treatment Plants". Federal Water Pollution Control Administration. Washington, D.C.: 1970

☆U.S. GOVERNMENT PRINTING OFFICE:1973 514-156/368 1-3